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Walliser

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(45) **Date of Patent: Dec. 29, 2015**

(54) **HYDROPONIC METHOD AND SYSTEM**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 124 days.

(21) Appl. No.: **13/662,134**

(22) Filed: **Oct. 26, 2012**

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Related U.S. Application Data

(60) Provisional application No. 61/551,431, filed on Oct. 26, 2011.

(51) **Int. Cl.**
A01G 31/00 (2006.01)
A01G 31/02 (2006.01)

(52) **U.S. Cl.**
CPC ***A01G 31/02*** (2013.01)

(58) **Field of Classification Search**
CPC E04B 7/102; A61G 9/14; A01G 31/00; A01G 31/02; A01G 9/14
USPC 119/226, 228, 233; 135/124; 52/81.1, 52/80.1
See application file for complete search history.

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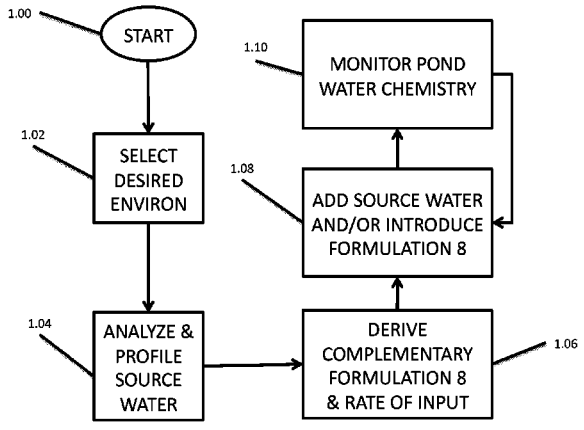
Assistant Examiner — Ebony Evans
(74) *Attorney, Agent, or Firm* — Stoel Rives LLP

(57) **ABSTRACT**

A hydroponic pond is provided that has a depth in the approximate range from 24 inches to 36 inches. This depth of pond water provides a volume of water that increases thermal stability of the hydroponic pond. A nutritional formulation is developed in view of an analysis of a source water make-up for combination with the source water to achieve a desired chemical and nutritional mix. The nutritional formulation and the source water are then combined and placed within a hydroponic pond. A computational system is provided that monitors the state of a hydroponic environment and directs input modules as programmed and in order to sponsor plant growth, plant quality, and volume of plant yield.

7 Claims, 19 Drawing Sheets



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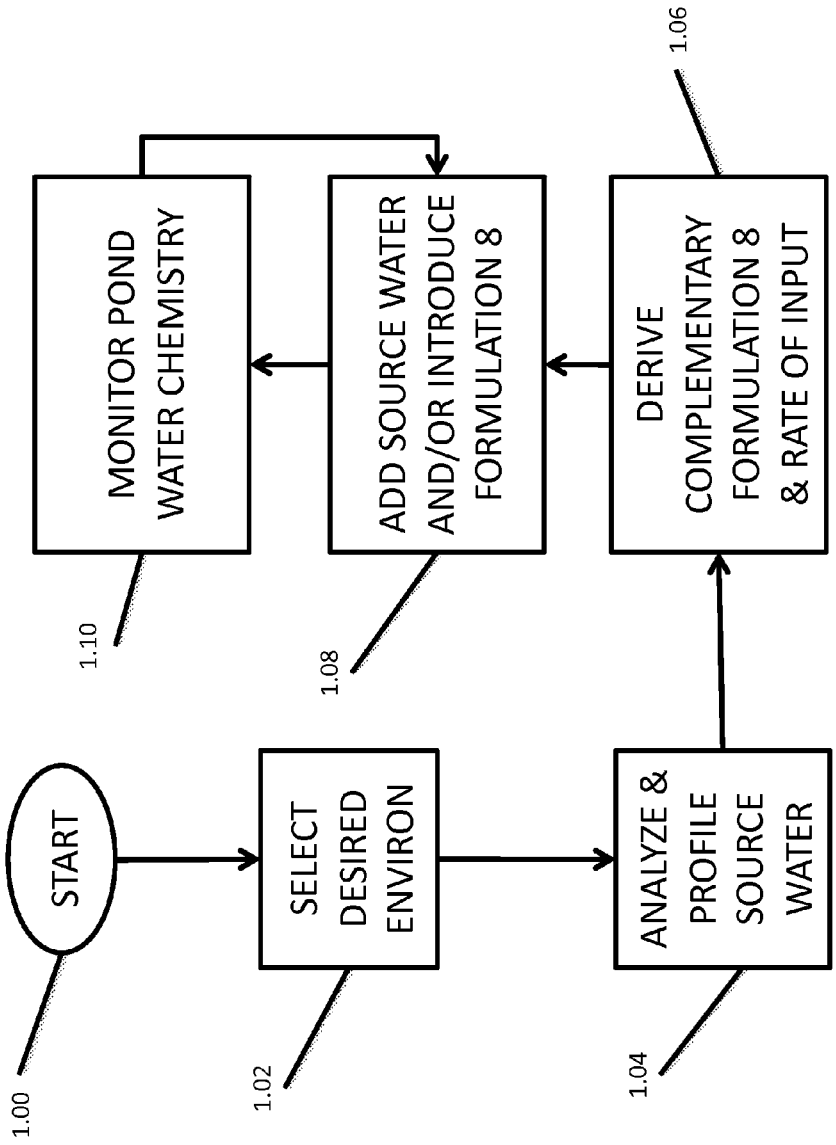

START
SELECT DESIRED ENVIRON
ANALYZE & PROFILE SOURCE WATER
DERIVE COMPLEMENTARY FORMULATION & RATE OF INPUT
ADD SOURCE WATER AND/OR INTRODUCE FORMULATION &
MONITOR POND WATER CHEMISTRY
1.00
1.02
1.04
1.06
1.08
1.10

FIGURE 1

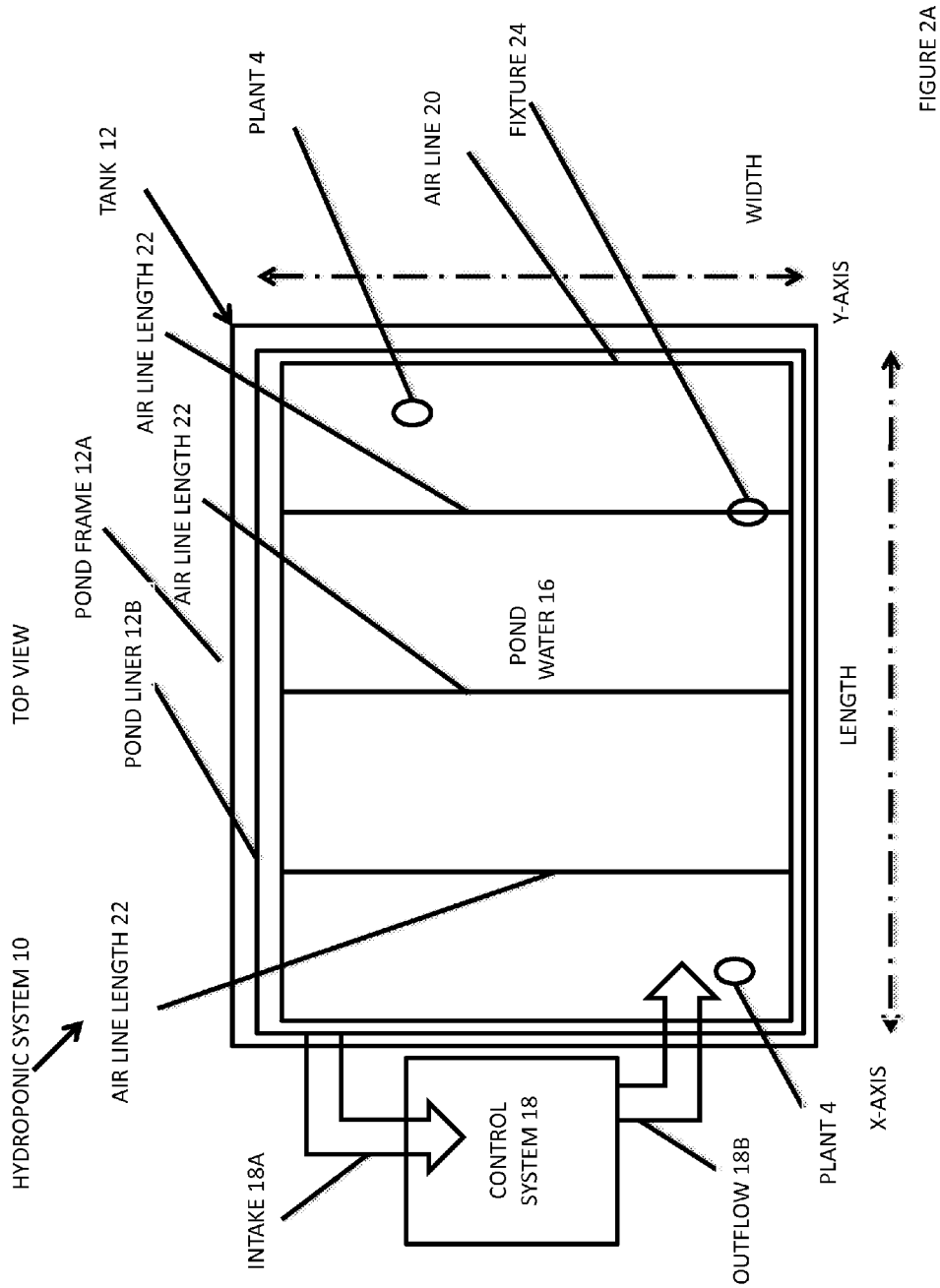

TOP VIEW
HYDROPONIC SYSTEM 10
AIR LINE LENGTH 22
POND LINER 12B
POND FRAME 12A
AIR LINE LENGTH 22
TANK 12
PLANT 4
AIR LINE 20
FIXTURE 24
WIDTH
Y-AXIS
POND WATER 16
LENGTH
X-AXIS
PLANT 4
OUTFLOW 18B
CONTROL SYSTEM 18
INTAKE 18A

FIGURE 2A

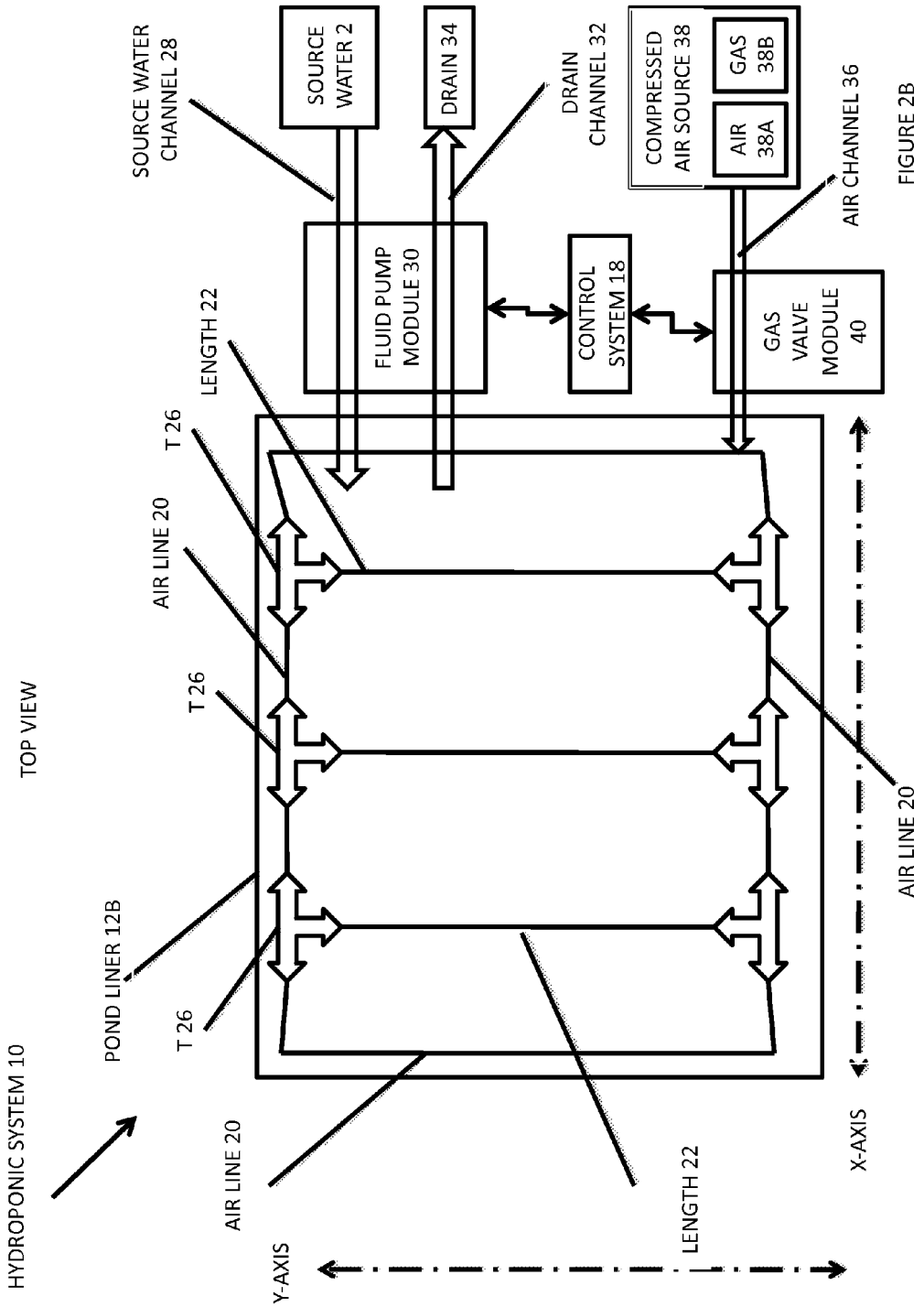

HYDROPONIC SYSTEM 10
TOP VIEW
POND LINER 12B
T 26
T 26
T 26
AIR LINE 20
AIR LINE 20
LENGTH 22
SOURCE WATER CHANNEL 28
SOURCE WATER 2
DRAIN 34
DRAIN CHANNEL 32
COMPRESSED AIR SOURCE 38
AIR 38A
GAS 38B
AIR CHANNEL 36
FLUID PUMP MODULE 30
CONTROL SYSTEM 18
GAS VALVE MODULE 40
AIR LINE 20
LENGTH 22
Y-AXIS
X-AXIS

FIGURE 2B

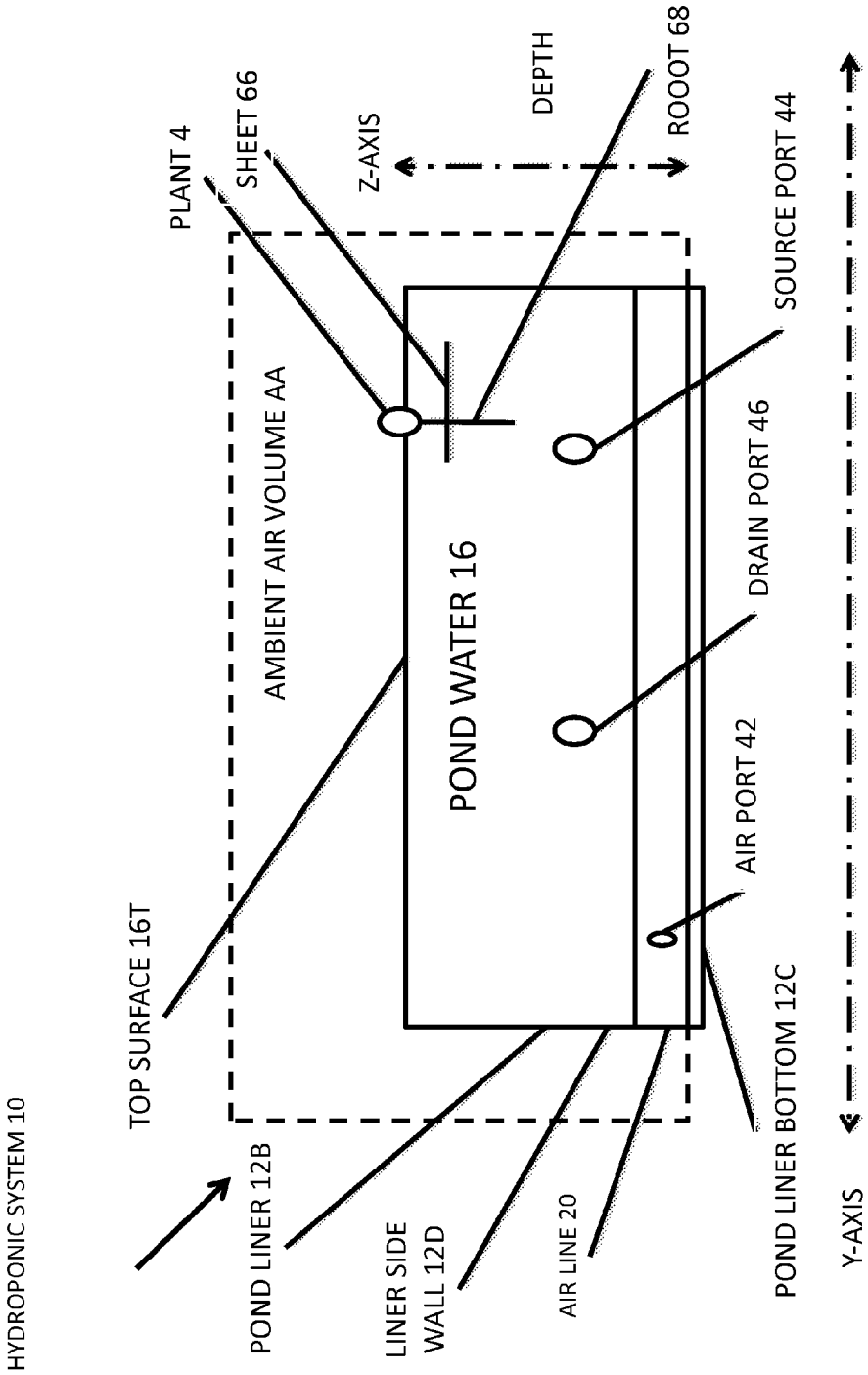
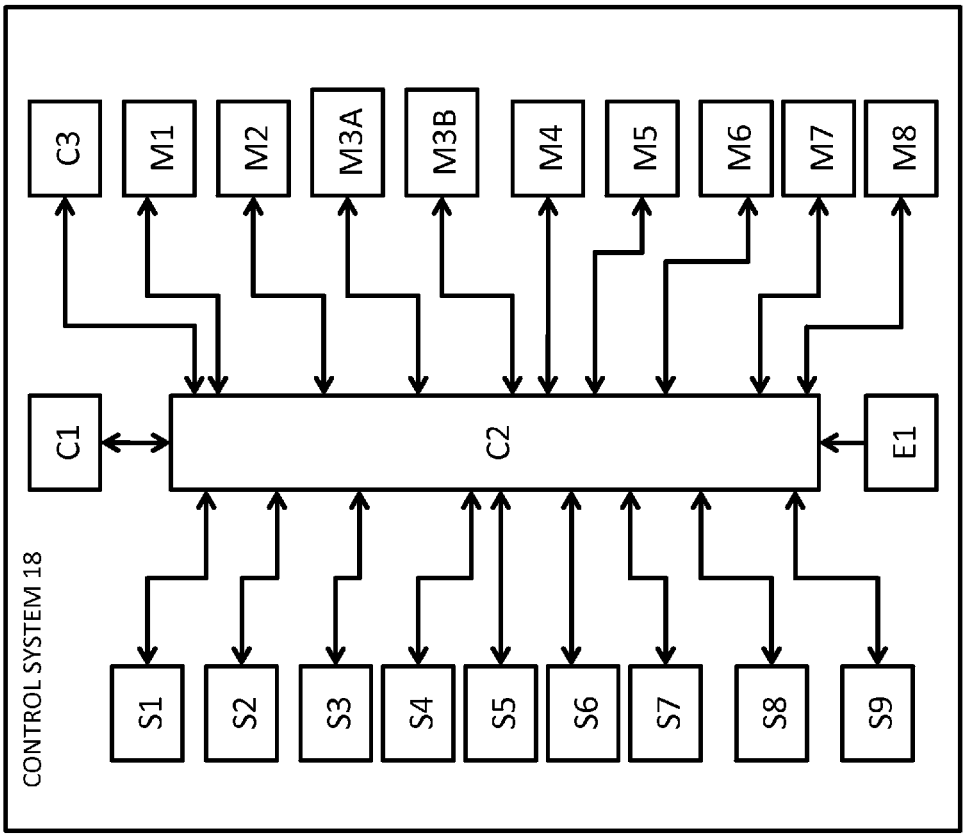

HYDROPONIC SYSTEM 10
TOP SURFACE 16T
POND LINER 12B
LINER SIDE WALL 12D
AIR LINE 20
POND LINER BOTTOM 12C
Y-AXIS
AMBIENT AIR VOLUME AA
POND WATER 16
AIR PORT 42
DRAIN PORT 46
SOURCE PORT 44
PLANT 4
SHEET 66
Z-AXIS
DEPTH
ROOT 68

FIGURE 3

FIGURE 4A


C3
M1
M2
M3A
M3B
M4
M5
M6
M7
M8
C1
C2
E1
S1
S2
S3
S4
S5
S6
S7
S8
S9
CONTROL SYSTEM 18

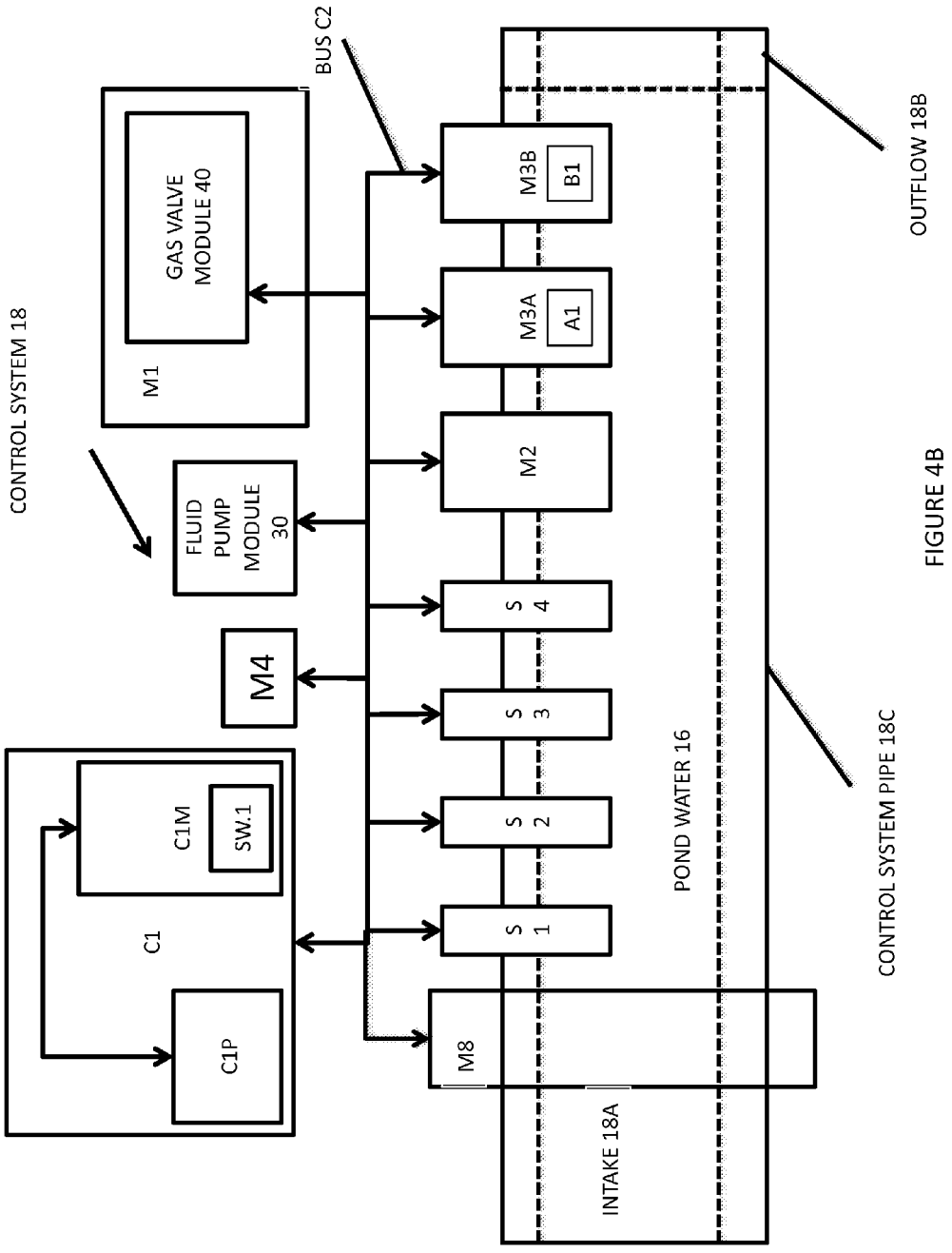

CONTROL SYSTEM 18
BUS C2
M1
GAS VALVE MODULE 40
FLUID PUMP MODULE 30
M4
C1
C1M
SW.1
C1P
M3B
B1
M3A
A1
M2
S 4
S 3
S 2
S 1
M8
POND WATER 16
INTAKE 18A
OUTFLOW 18B
CONTROL SYSTEM PIPE 18C

FIGURE 4B

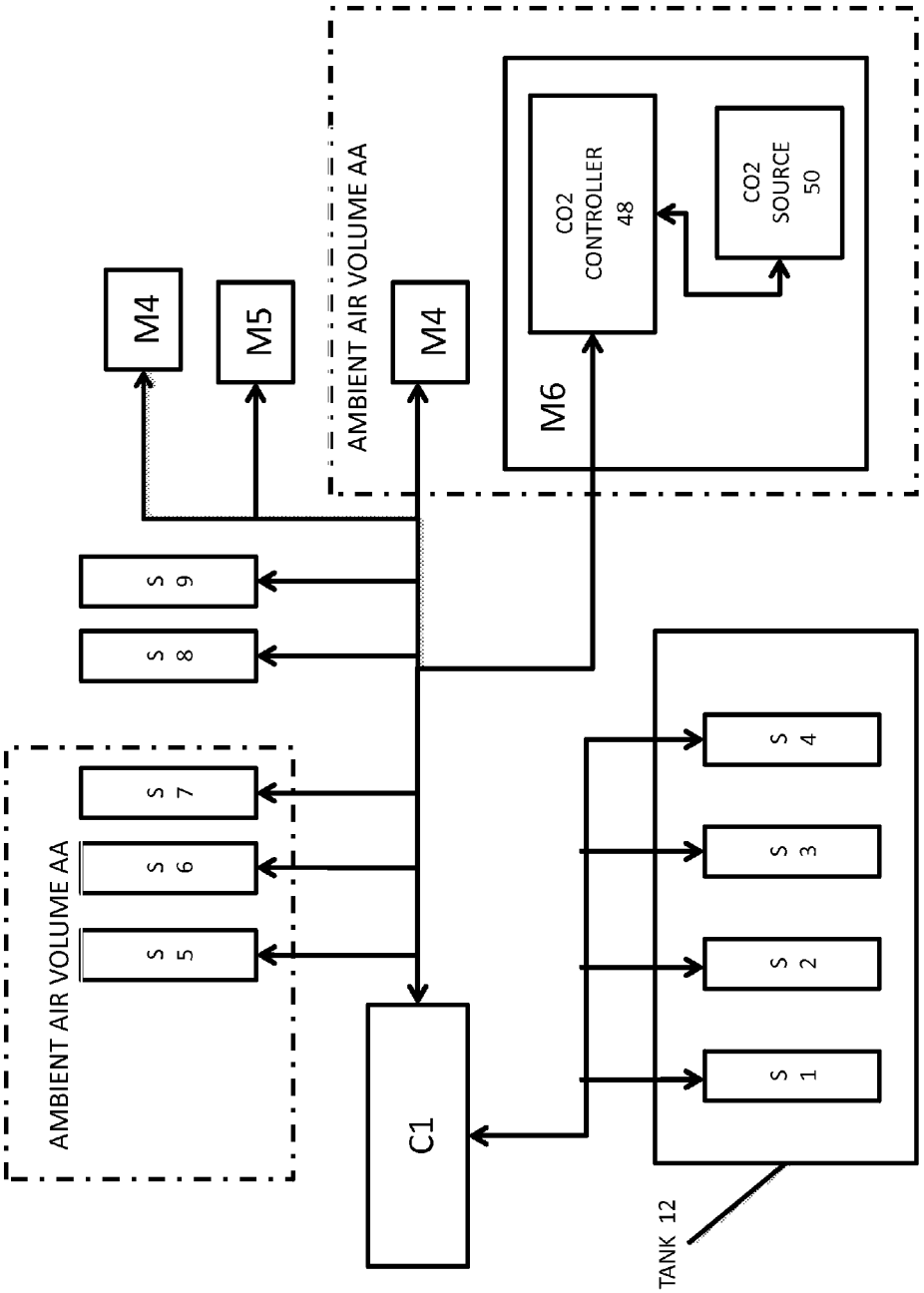

AMBIENT AIR VOLUME AA
M4
M5
M4
M6
CO2 CONTROLLER 48
CO2 SOURCE 50
S 9
S 8
AMBIENT AIR VOLUME AA
S 7
S 6
S 5
C1
S 4
S 3
S 2
S 1
TANK 12

FIGURE 4C

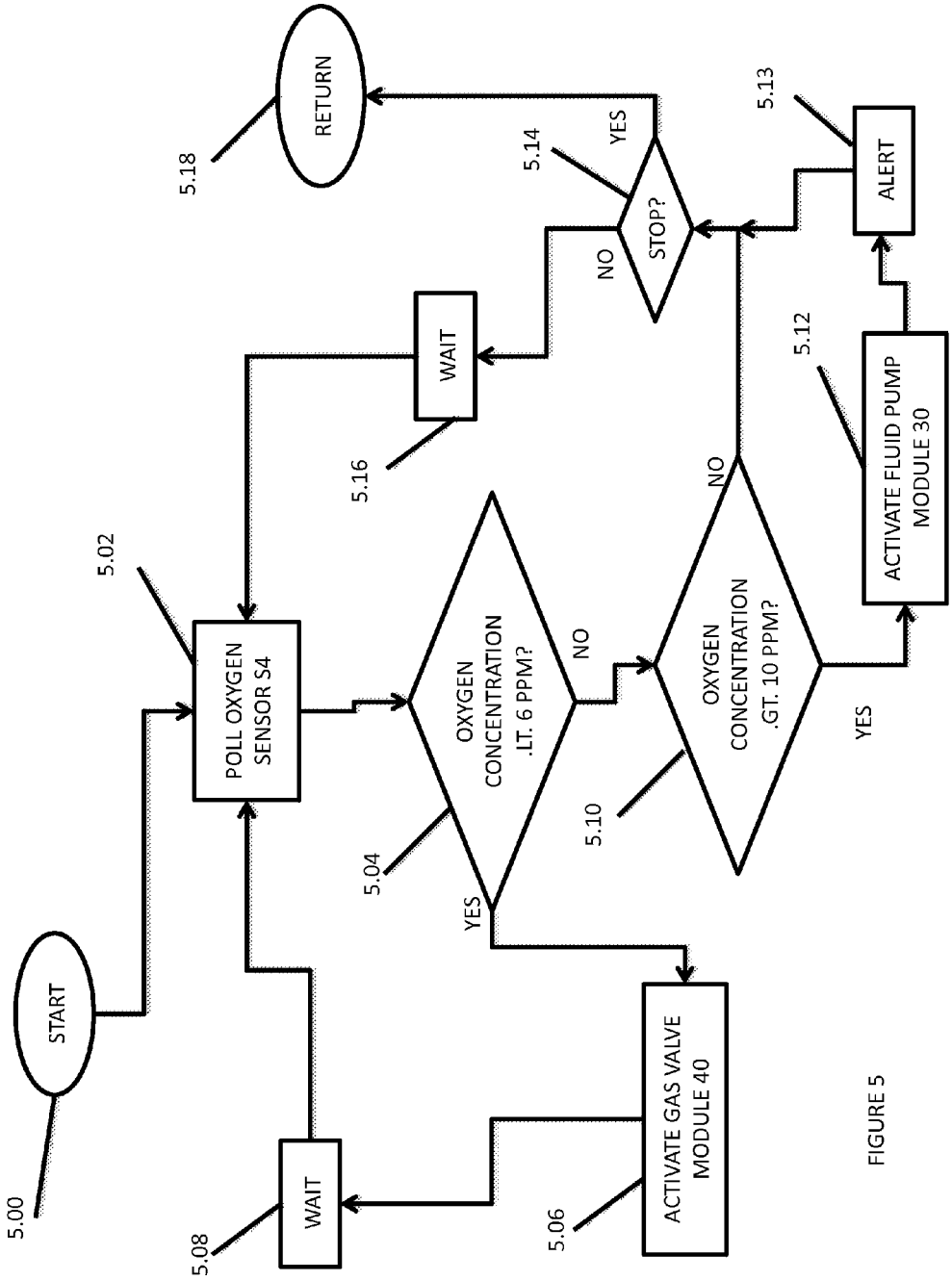

START
5.00
POLL OXYGEN SENSOR S4
5.02
OXYGEN CONCENTRATION .LT. 6 PPM?
5.04
YES
NO
OXYGEN CONCENTRATION .GT. 10 PPM?
5.10
NO
YES
ACTIVATE GAS VALVE MODULE 40
5.06
WAIT
5.08
WAIT
5.16
ACTIVATE FLUID PUMP MODULE 30
5.12
ALERT
5.13
STOP?
5.14
NO
YES
RETURN
5.18

FIGURE 5

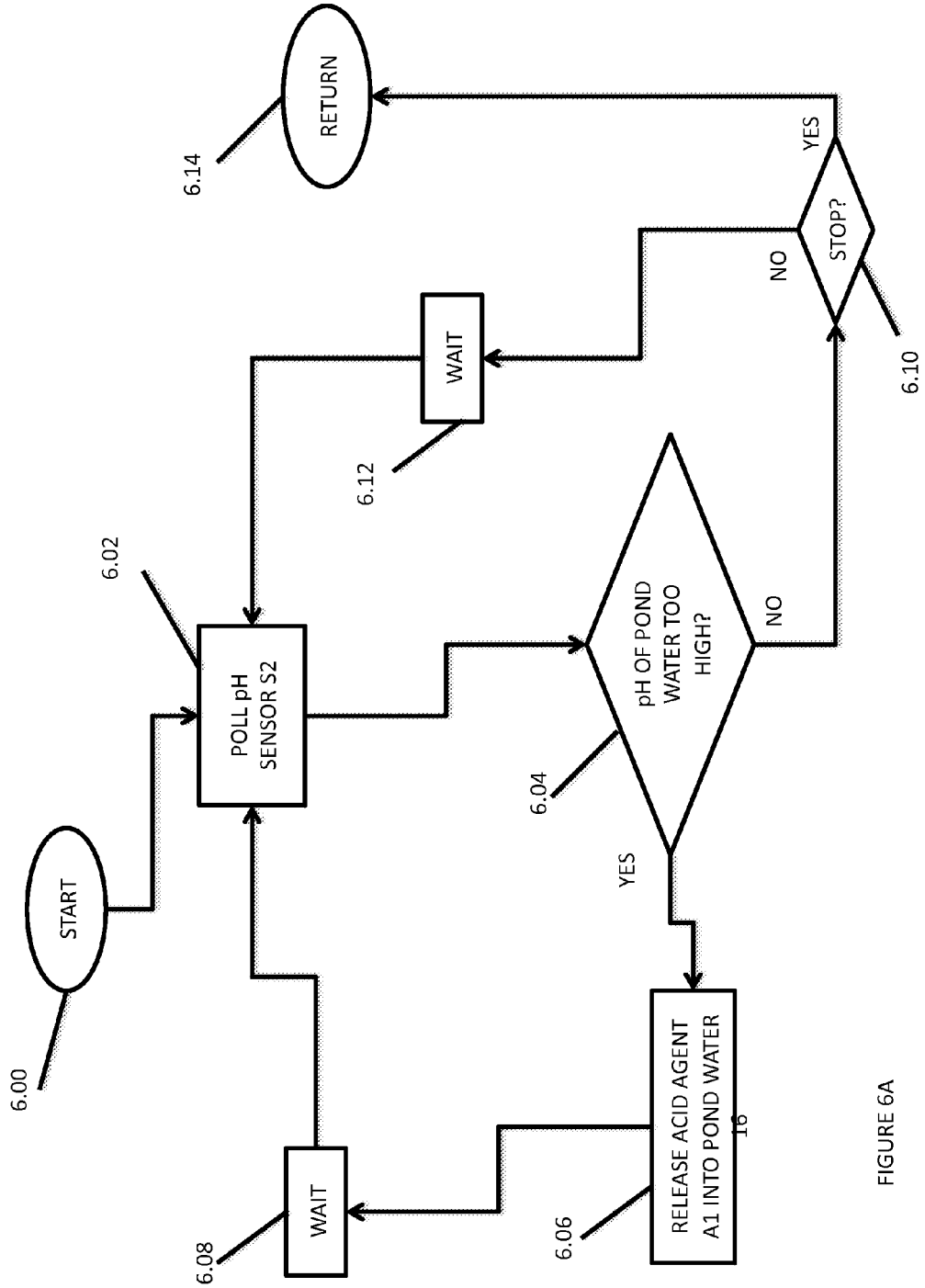

START
6.00
POLL pH SENSOR S2
6.02
pH OF POND WATER TOO HIGH?
6.04
NO
YES
RELEASE ACID AGENT A1 INTO POND WATER
16
6.06
WAIT
6.08
WAIT
6.12
STOP?
NO
YES
6.10
RETURN
6.14

FIGURE 6A

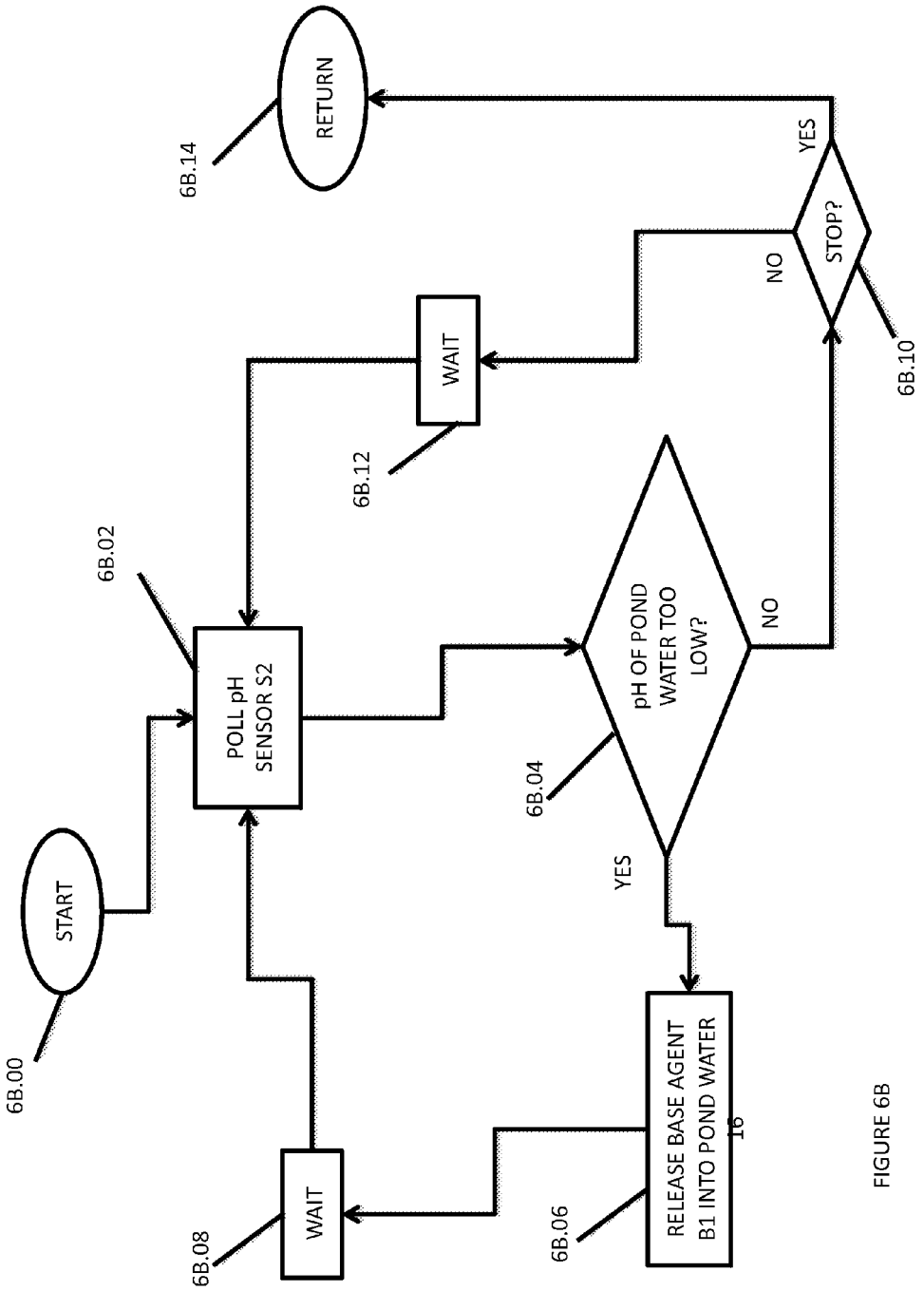

START
6B.00
POLL pH SENSOR S2
6B.02
pH OF POND WATER TOO LOW?
6B.04
YES
NO
RELEASE BASE AGENT B1 INTO POND WATER 16
6B.06
WAIT
6B.08
WAIT
6B.12
STOP?
YES
NO
6B.10
RETURN
6B.14

FIGURE 6B

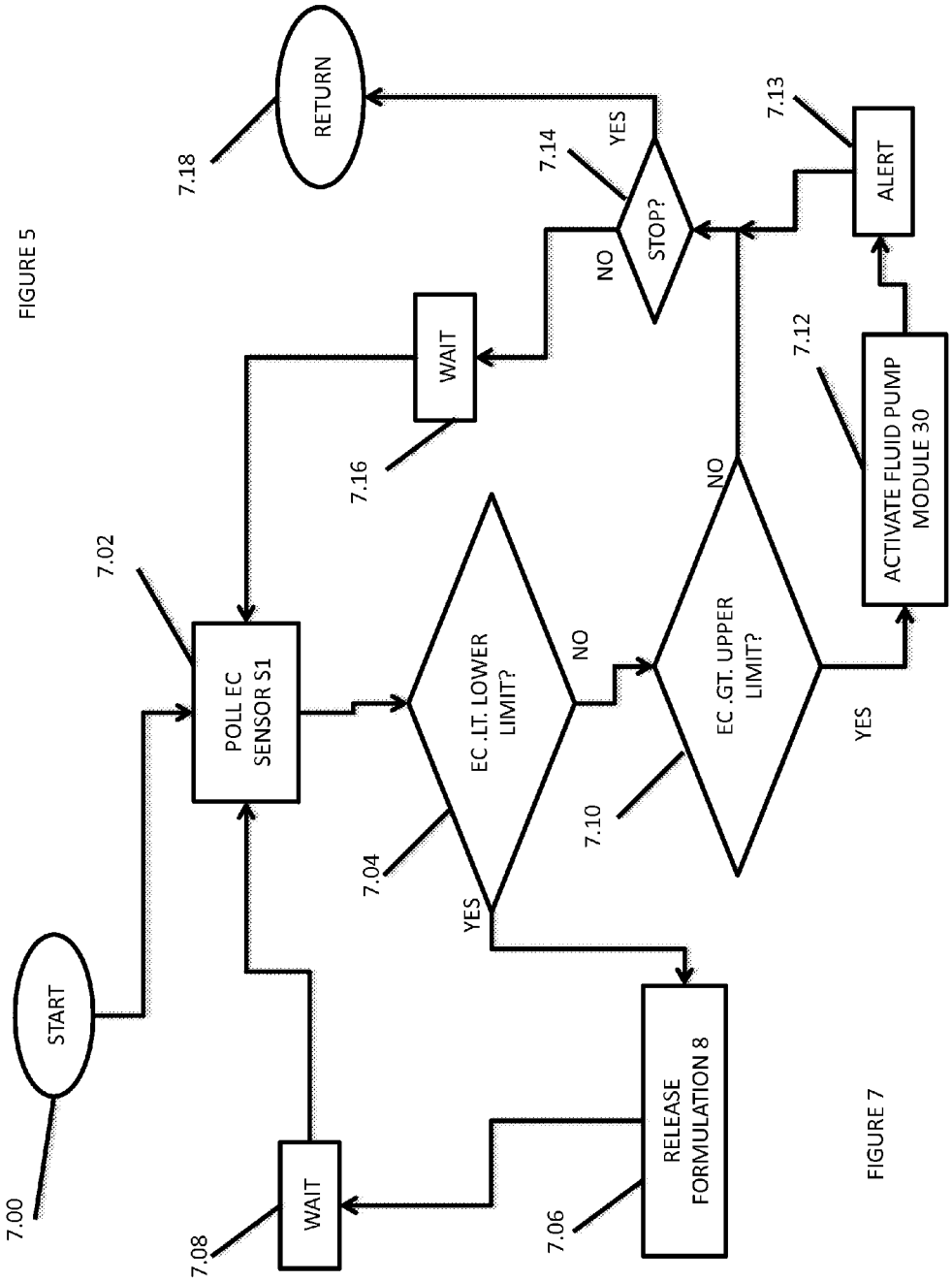


FIGURE 5

FIGURE 7

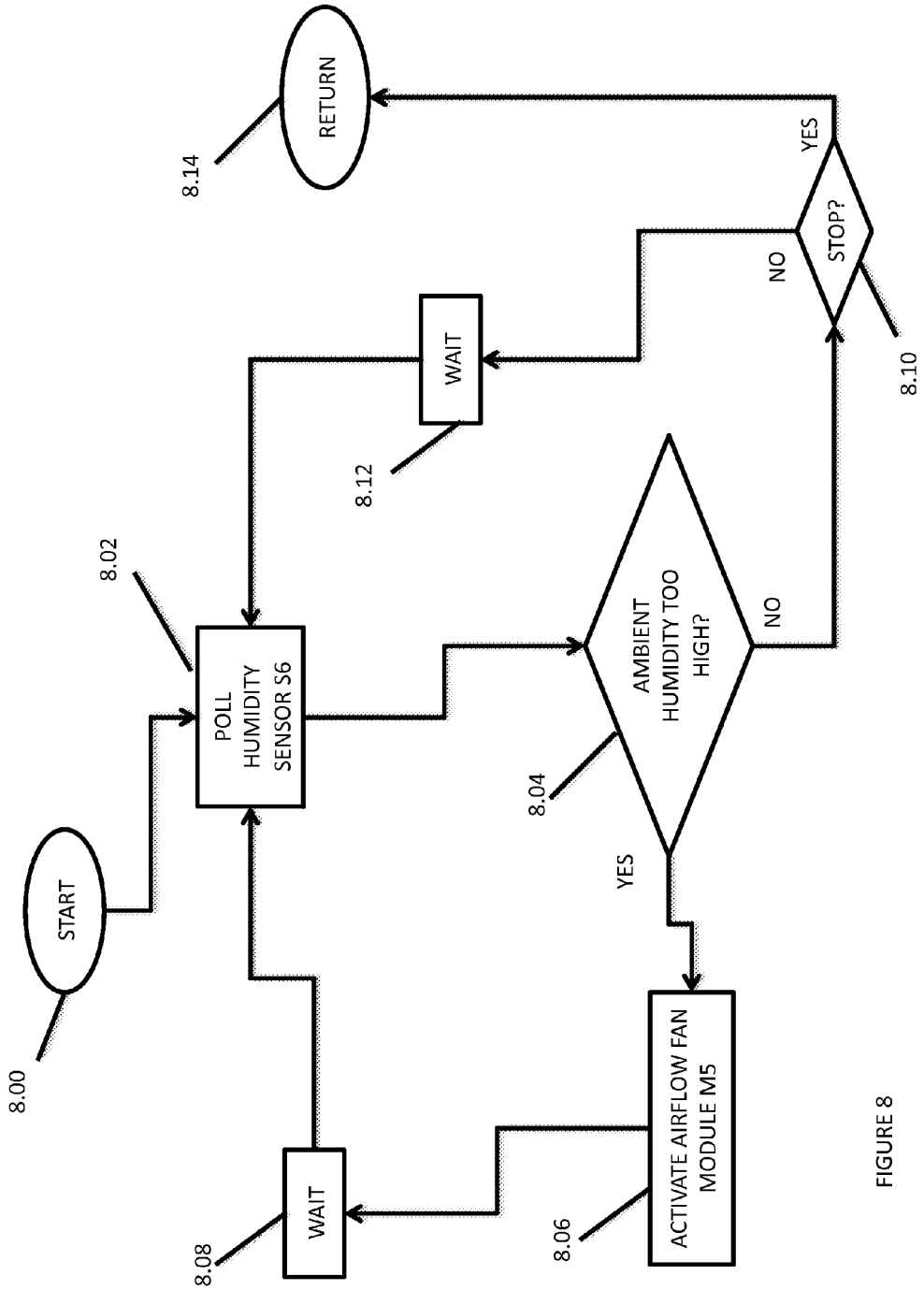

START
8.00
POLL HUMIDITY SENSOR S6
8.02
AMBIENT HUMIDITY TOO HIGH?
8.04
NO
YES
ACTIVATE AIRFLOW FAN MODULE M5
8.06
WAIT
8.08
WAIT
8.12
STOP?
NO
YES
8.10
RETURN
8.14

FIGURE 8

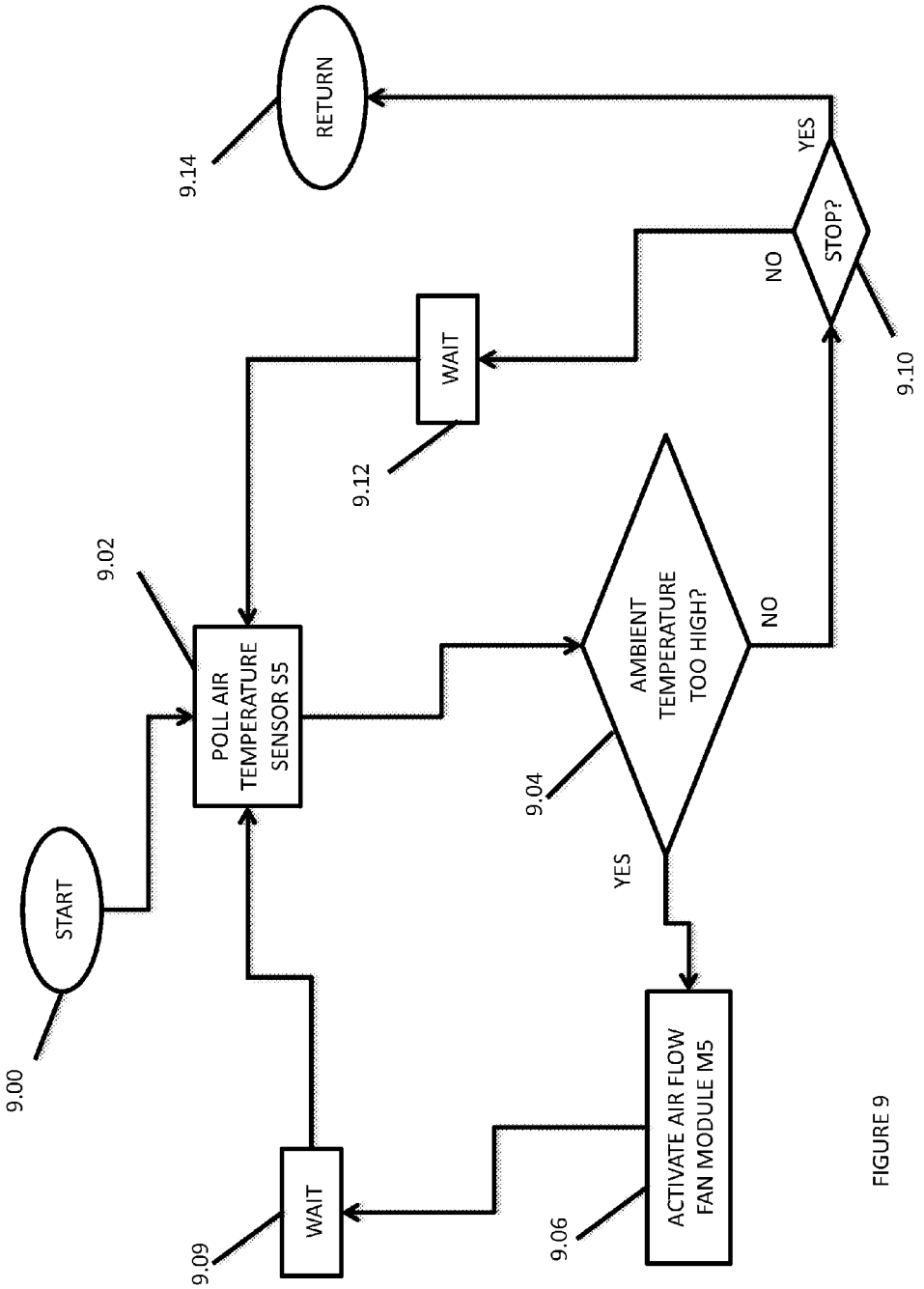

START
9.00
POLL AIR TEMPERATURE SENSOR S5
9.02
AMBIENT TEMPERATURE TOO HIGH?
9.04
NO
YES
ACTIVATE AIR FLOW FAN MODULE M5
9.06
WAIT
9.09
WAIT
9.12
STOP?
9.10
NO
YES
RETURN
9.14

FIGURE 9

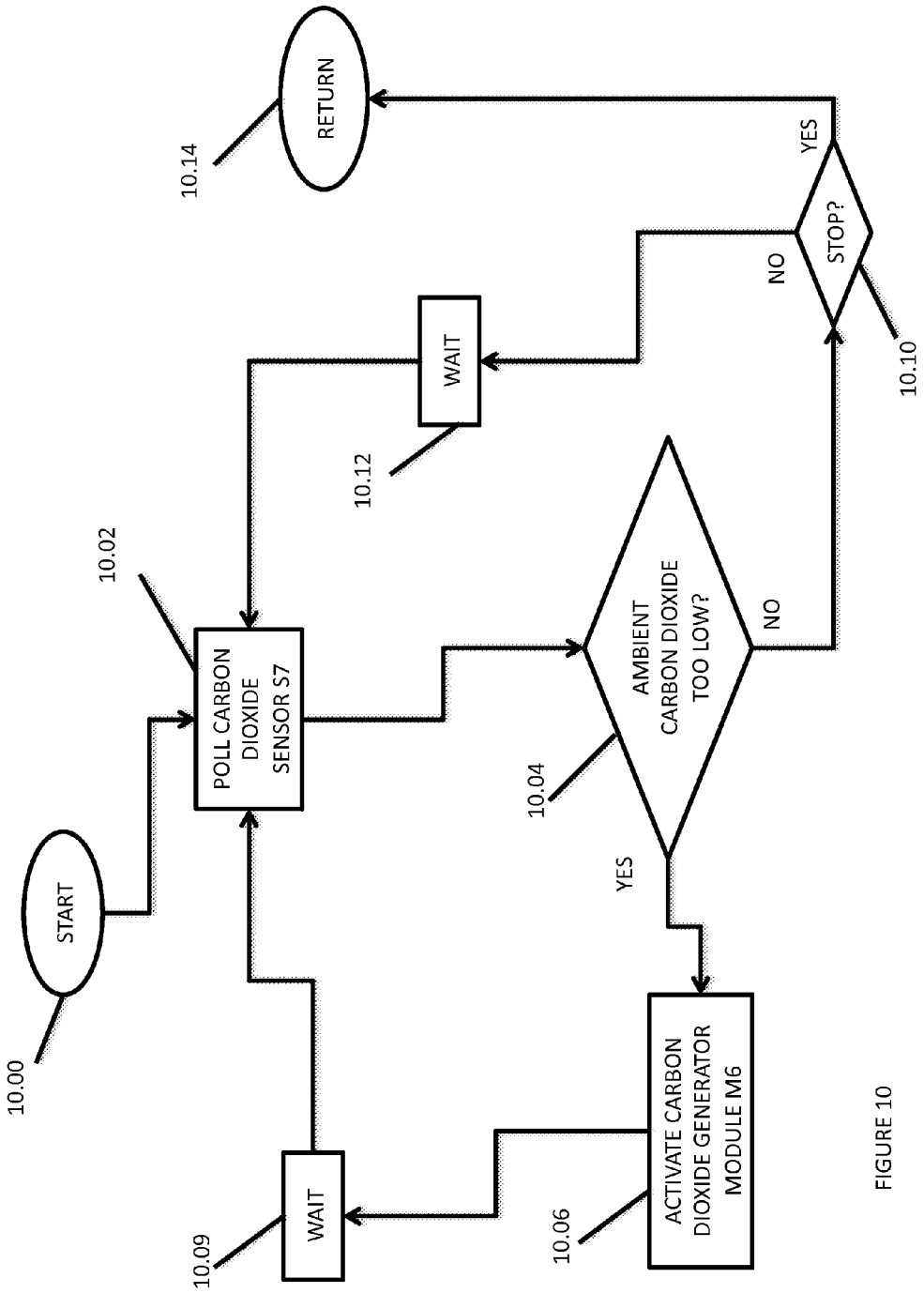

START
10.00
POLL CARBON DIOXIDE SENSOR S7
10.02
AMBIENT CARBON DIOXIDE TOO LOW?
10.04
NO
YES
ACTIVATE CARBON DIOXIDE GENERATOR MODULE M6
10.06
WAIT
10.09
WAIT
10.12
STOP?
10.10
NO
YES
RETURN
10.14

FIGURE 10

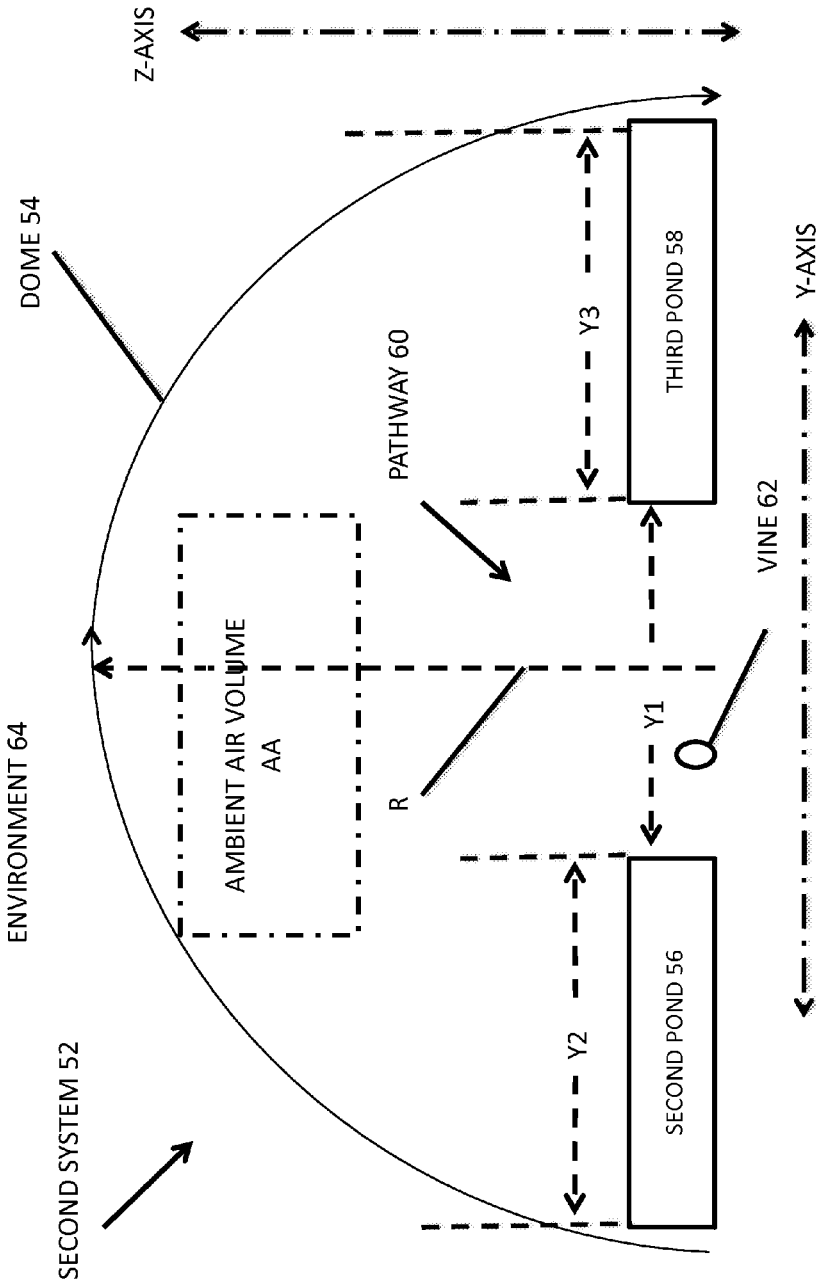

Z-AXIS
DOME 54
PATHWAY 60
Y3
THIRD POND 58
Y-AXIS
VINE 62
AMBIENT AIR VOLUME
AA
R
Y1
ENVIRONMENT 64
Y2
SECOND POND 56
SECOND SYSTEM 52

FIGURE 11

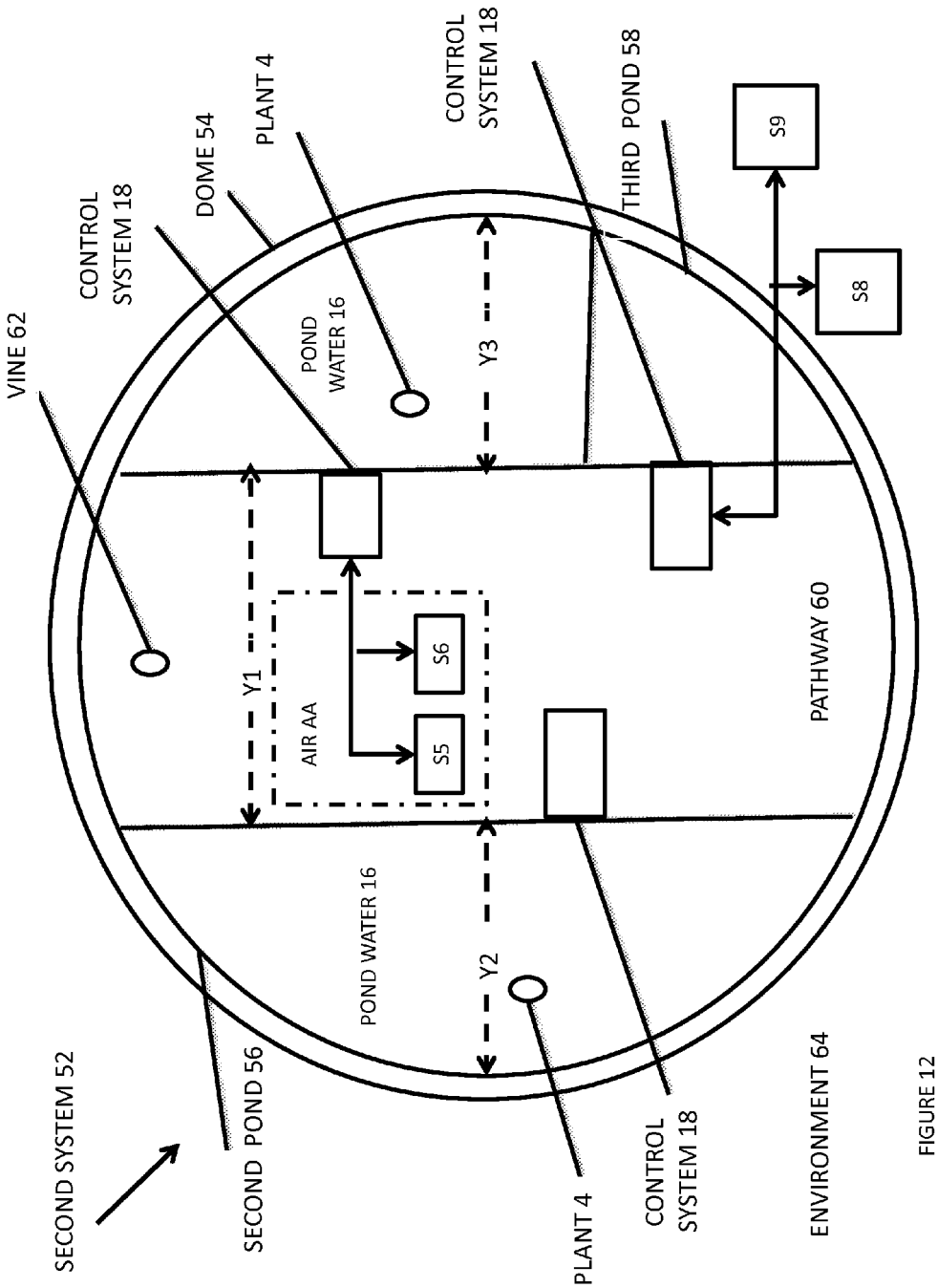

SECOND SYSTEM 52
SECOND POND 56
PLANT 4
CONTROL SYSTEM 18
ENVIRONMENT 64
POND WATER 16
Y2
Y1
AIR AA
S6
S5
PATHWAY 60
Y3
POND WATER 16
VINE 62
CONTROL SYSTEM 18
DOME 54
PLANT 4
CONTROL SYSTEM 18
THIRD POND 58
S9
S8

FIGURE 12

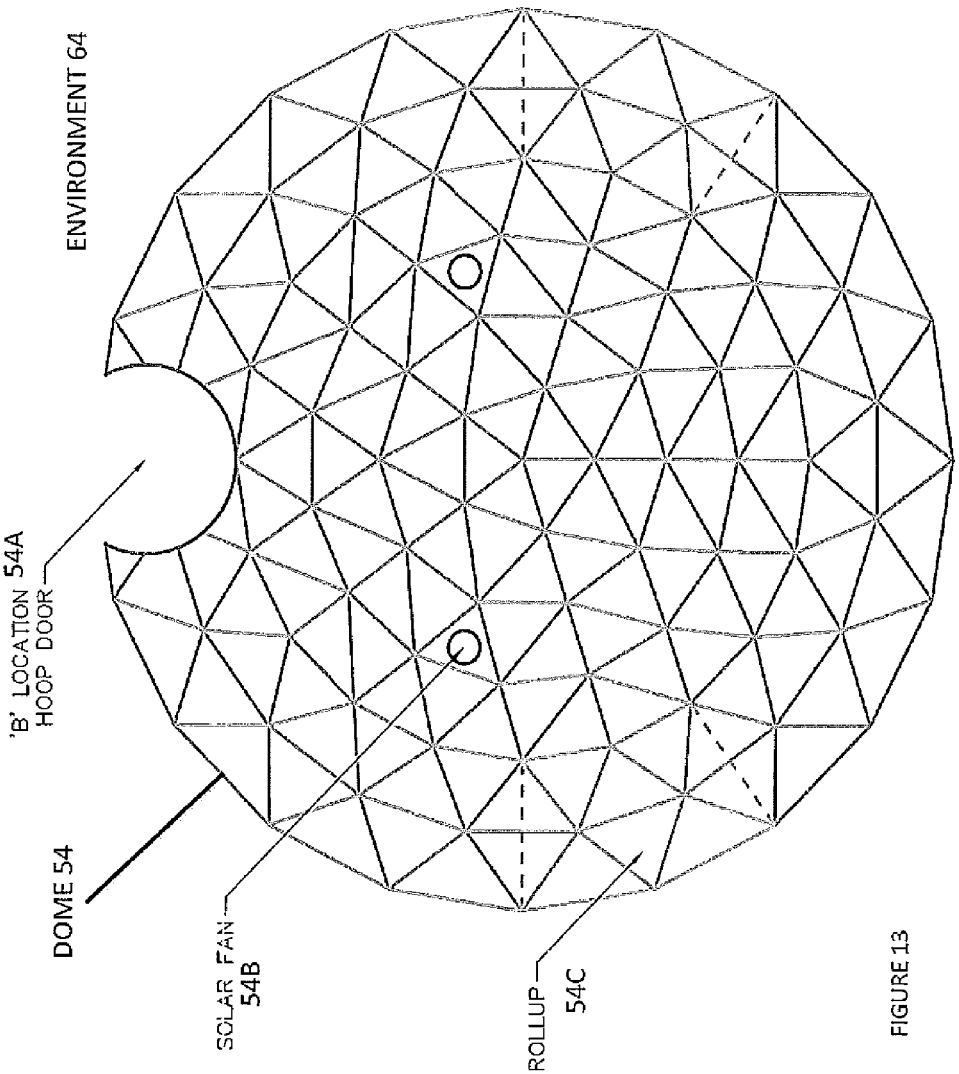

ENVIRONMENT 64
'B' LOCATION 54A
HOOP DOOR
DOME 54
SOLAR FAN
54B
ROLLUP
54C

FIGURE 13

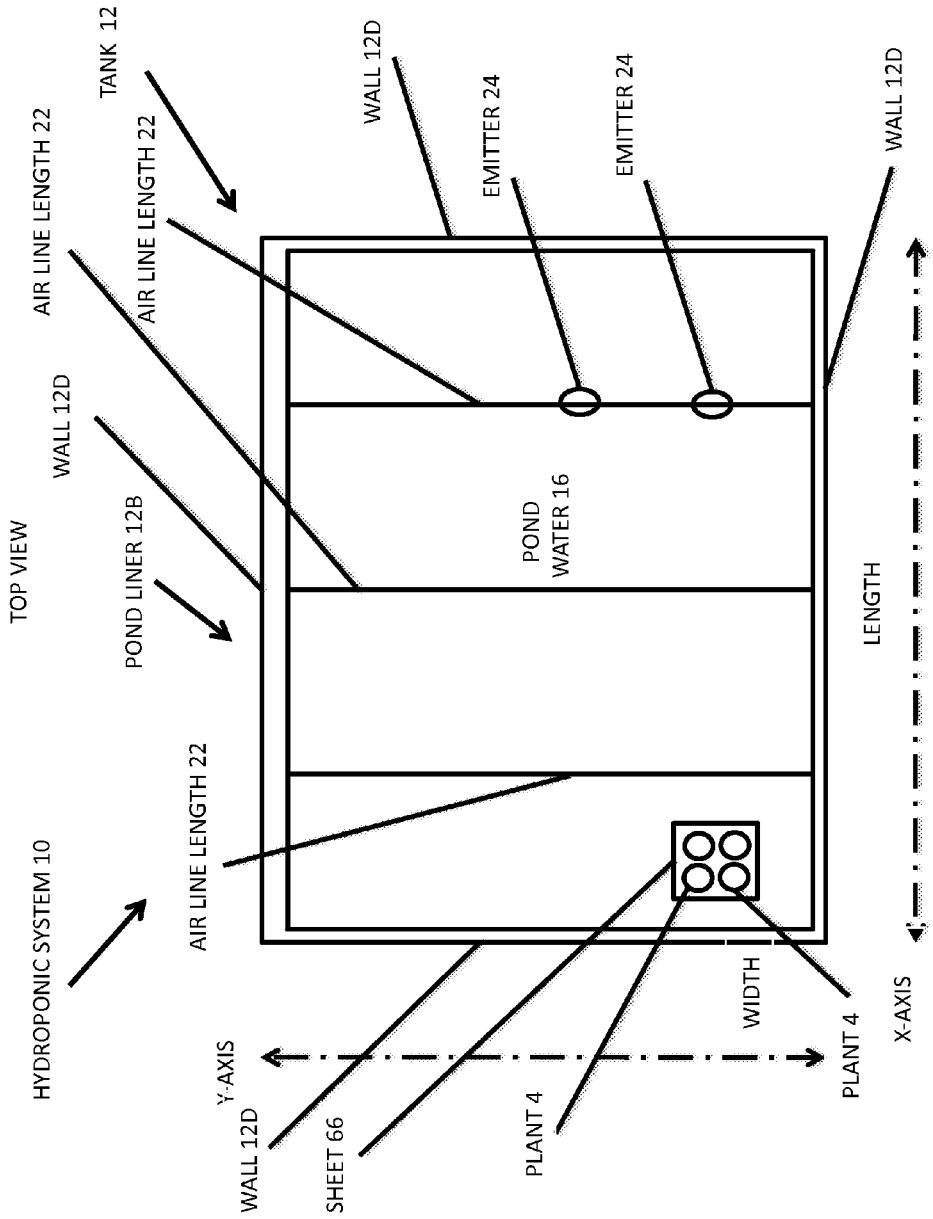

TOP VIEW
HYDROPONIC SYSTEM 10
TANK 12
AIR LINE LENGTH 22
AIR LINE LENGTH 22
AIR LINE LENGTH 22
WALL 12D
WALL 12D
WALL 12D
WALL 12D
POND LINER 12B
EMITTER 24
EMITTER 24
POND WATER 16
LENGTH
WIDTH
Y-AXIS
X-AXIS
PLANT 4
PLANT 4
SHEET 66

FIGURE 14

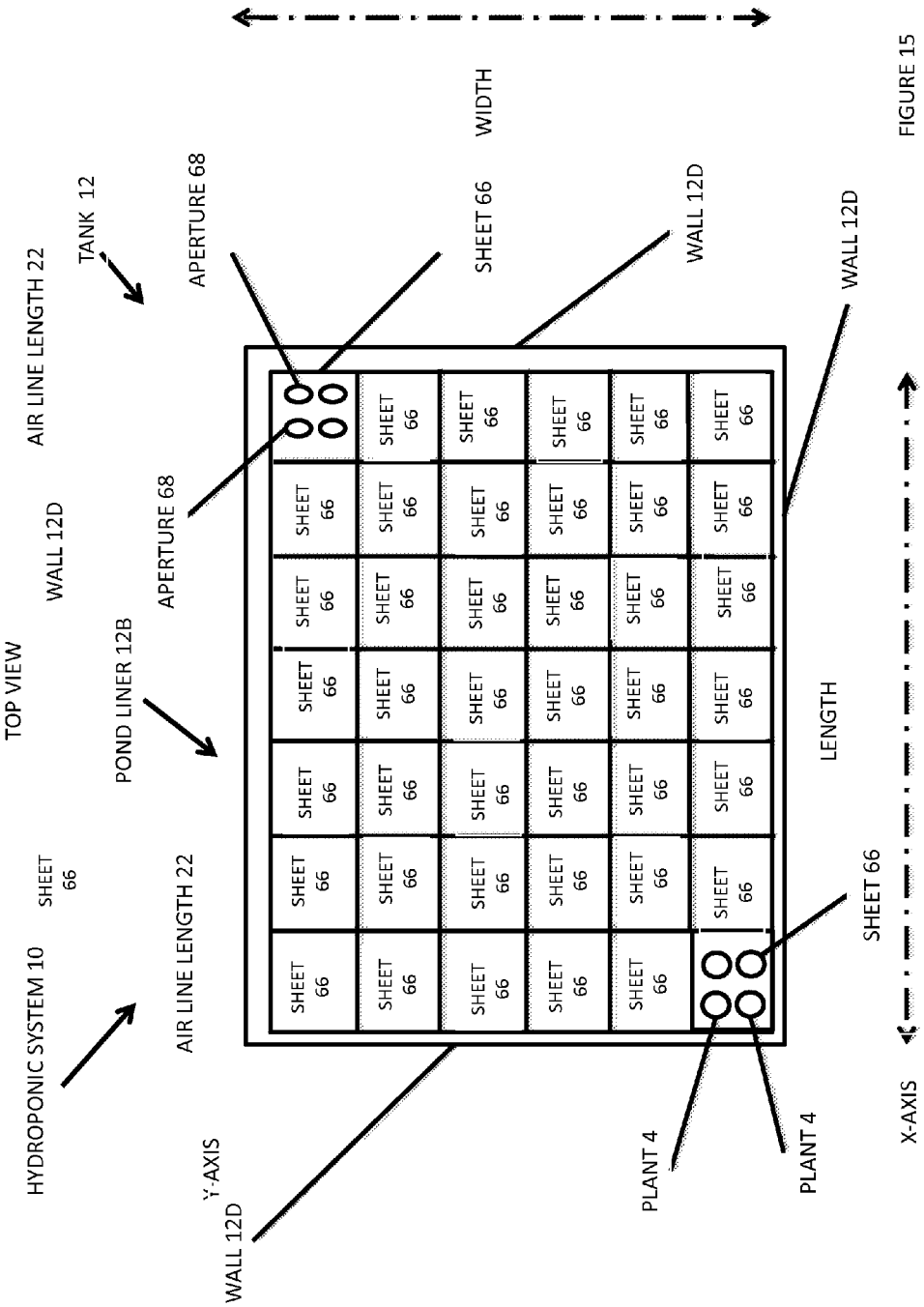

TOP VIEW
HYDROPONIC SYSTEM 10
SHEET 66
AIR LINE LENGTH 22
POND LINER 12B
WALL 12D
APERTURE 68
TANK 12
AIR LINE LENGTH 22
WALL 12D
APERTURE 68
SHEET 66
WIDTH
WALL 12D
WALL 12D
LENGTH
SHEET 66
Y-AXIS
WALL 12D
PLANT 4
PLANT 4
X-AXIS

FIGURE 15

HYDROPONIC METHOD AND SYSTEM

RELATED APPLICATION

This application claims the benefit of the filing date of U.S. Provisional Patent Application No. 61/551,431, filed Oct. 26, 2011 and titled HYDROPONIC METHOD AND SYSTEM and which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

The present disclosure relates to hydroponic agriculture. More particularly, the present disclosure relates to methods and systems for use in nurturing and harvesting plants in hydroponic environments.

BACKGROUND INFORMATION

Hydroponic technology is being increasingly deployed for growing food and medicinal crops. Improvements in crop yield per unit of resource expended in hydroponic settings can generate significant benefits to many agricultural operations and thereby address society's increasing needs for resource-efficient agriculture.

The prior art teaches that shallow pools, i.e., ponds having depths in a range from 0.125 inch to 0.25 inch, are preferred in order to maximize yield per resource input. In addition, the prior art teaches toward filtering source water prior to use in a hydroponic pond, although filtering source water can be resource intensive.

The prior art fails to optimally manage and apply to hydroponic agriculture essential crop inputs, such as water, oxygen, nutrients, heat, and electricity, to maximize volume and quality of crop production.

SUMMARY OF THE DISCLOSURE

Disclosed are techniques enabling improvements in hydroponic agriculture.

In a first aspect of the method of the present disclosure, a source water is examined to determine its chemical and biochemical make-up. This source water make-up is then compared with the desired chemical and nutritional mix that are provided to plants in a hydroponic setting. A nutritional formulation is then developed in view of the source water make-up to combine with the source water and to result in the desired chemical and nutritional mix. The nutritional formulation and the source water are then combined and placed within a hydroponic pond.

According to a second aspect of the method of the present disclosure, a computational system is provided that monitors the state of a hydroponic environment and directs input modules as programmed and in order to sponsor plant growth, plant quality, and volume of plant yield. The computational system (hereinafter, "control system") may optionally include sensors that monitor one or more environmental parameters, to include pond water temperature, electrical conductivity of the pond water, pond water salinity, oxygen concentration of the pond water, pH of the pond water, ambient air temperature, ambient air humidity, and/or sunlight energy intensity. In certain embodiments of the method of the present disclosure, salinity is indirectly measured by measuring the electrical conductivity of the pond water.

The control system may optionally include one or more input modules that dispense or mitigate oxygen concentration of the pond water, nutritional additives, sulphuric acid, phosphoric acid, and/or other suitable acidic material known in the art. The system may optionally include an input material having a base pH input material, such as potassium hydroxide and/or other suitable acidic material known in the art.

Additionally or alternatively, the control system may include a shading system that controllably shields the pond water and ambient air volume from sunlight. Still additionally or alternately, the control system may include motorized fans that enable control or mitigation of air flow into the pond environment and/or air flow away from the pond environment.

According to a third optional aspect of the method, a hydroponic pond is provided that has a depth in an approximate range from 18 inches to 36 inches. This depth of pond water provides a volume of water that increases thermal stability of the hydroponic pond.

According to a fourth optional aspect of the method, a substantially hemispheric dome is provided that substantially shields and covers one or more hydroponic ponds and may further enclose an additional growth area for additional plants, such as vines.

INCORPORATION BY REFERENCE

All publications mentioned herein are incorporated herein by reference to disclose and describe the methods and/or materials in connection with which the publications are cited. All publications, patents, and patent applications mentioned in this specification are herein incorporated by reference in their entirety and for all purposes to the same extent as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference.

Such incorporations include U.S. Pat. No. 7,861,459 titled "Hydroponic plant nutrient circulation/distribution system"; U.S. Pat. No. 7,818,916 titled "pH buffered plant nutrient compositions and methods for growing plants"; U.S. Pat. No. 7,335,291 titled "Water treating method, water treating apparatus, and hydroponics system using the apparatus"; U.S. Pat. No. 7,069,691 titled "Hydroponics plant cultivation assembly for diverse sizes of pots and plants"; U.S. Pat. No. 6,843,910 titled "Ornamental pond"; U.S. Pat. No. 6,000,173 titled "Hydroponic growing station with intermittent nutrient supply"; U.S. Pat. No. 5,755,852 titled "Bioconverted nutrient rich humus"; U.S. Pat. No. 5,224,294 titled "Hydroponic growth system"; U.S. Pat. No. 5,121,708 titled "Hydroculture crop production system"; U.S. Pat. No. 5,054,233 titled "Hydroponic apparatus"; and U.S. Pat. No. 4,170,844 titled "Hydroponic gardening method and system".

In addition, each and all publications, patents, and patent applications mentioned in this specification are herein incorporated by reference to the same extent in their entirety and for all purposes as if each individual publication, patent, or patent application was specifically and individually indicated to be incorporated by reference. The publications discussed or mentioned herein are provided solely for their disclosure prior to the filing date of the present application. Nothing herein is to be construed as an admission that the present disclosure is not entitled to antedate such publication by virtue of prior invention.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

These, and further features of the disclosure, may be better understood with reference to the accompanying specification and drawings depicting embodiments, in which:

FIG. **1** is a process chart of the first aspect of the method of the present disclosure, wherein a nutritional formulation is developed in view of a source water make-up to combine with the source water to result in a desired chemical and nutritional mix;

FIG. **2**A is a top view of a hydroponic pond system, according to one embodiment;

FIG. **2**B is a schematic diagram of aspects of the hydroponic system of FIG. **2**A;

FIG. **3** is a cut-away side view of the hydroponic pond system of FIGS. **2**A and **2**B;

FIG. **4**A is a schematic of a control system that is applicable to manage parameters of the hydroponic system of FIGS. **2**A and **2**B;

FIG. **4**B is a partial schematic of the hydroponic system of FIGS. **2**A and **2**B, and presents aspects of the control system of FIG. **4**A;

FIG. **4**C is a partial schematic of the hydroponic system of FIGS. **2**A and **2**B, and presents alternative and additional aspects of the control system of FIG. **4**A;

FIG. **5** is a first control loop applied by the control system of FIG. **4**A to maintain an oxygen level in the pond water above six parts per million;

FIG. **6**A is a second control loop applied by the control system of FIG. **4**A to maintain a pH level in the pond water below a preselected value;

FIG. **6**B is a third control loop applied by the control system of FIG. **4**A to maintain a pH level in the pond water above a preselected value;

FIG. **7** is a fourth control loop applied by the control system of FIG. **4**A to maintain a salinity of the pond water below a preselected salinity value;

FIG. **8** is a fifth control loop applied by the control system of FIG. **4**A to maintain the humidity of the ambient air of the hydroponic pond system below a preselected value;

FIG. **9** is a sixth control loop applied by the control system of FIG. **4**A to maintain the temperature of the ambient air of the hydroponic pond system below a preselected value;

FIG. **10** is a seventh control loop applied by the control system of FIG. **4**A to maintain the carbon dioxide of the ambient air of the hydroponic pond system above a preselected value;

FIG. **11** is a side view of a second system comprising a hemispheric dome and two hydroponic tanks;

FIG. **12** is a top view of a second system of FIG. **11**;

FIG. **13** is an isolated and detailed top view of aspects of the second system and hemispheric dome FIGS. **11** and **12**;

FIG. **14** is a detailed top view of selected optional aspects of the air line lengths and gas emitters of the hydroponic pond system of FIGS. **2**A, **2**B and **3**; and

FIG. **15** is a detailed top view of yet other selected optional aspects of the system of floating sheets of material that support the plants of FIGS. **2**A, **2**B, **3**, and **14**.

DESCRIPTION OF EMBODIMENTS

It is to be understood that this disclosure is not limited to particular aspects of described embodiments, as embodiments may, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular aspects only, and is not intended to be limiting, since the scope of the present disclosure will be limited only by the appended claims.

Methods recited herein may be carried out in any order of the recited events which is logically possible, as well as the recited order of events.

Where a range of values is provided herein, the range is inclusive of upper and lower values and any intermediate values therebetween.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. Although any methods and materials similar or equivalent to those described herein can also be used in the practice or testing of the present disclosure, the methods and materials are now described.

It must be noted that as used herein and in the appended claims, the singular forms "a", "an", and "the" include plural referents unless the context clearly dictates otherwise. It is further noted that the claims may be drafted to exclude any optional element. As such, this statement is intended to serve as antecedent basis for use of such exclusive terminology as "solely," "only" and the like in connection with the recitation of claim elements, or use of a "negative" limitation.

Referring now to FIG. **1**, a source water **2** is examined to determine its chemical and biochemical make-up. In step **1.02** a desirable mixture of concentrations of nutrients and other inputs relative to a source water volume is determined or selected. The chemical make-up of the source water **2** is then analyzed in step **1.04** and its constituents and their concentrations within the a sample volume of the source water **2** is documented in step **1.04**.

This analysis of the source water **2** is then compared in step **1.06** with the desired chemical and nutritional mix that are provided to plants **4** in a hydroponic pond **6**, and the complementary formulation **8** of chemical and optionally biochemical constituents is derived and developed in view of the results of the source water analysis of step **1.04**. Optionally or additionally, a desired rate of input into the hydroponic pond **6** of one or more components of the complementary formulation **8** may also be determined in step **1.06**.

The complementary formulation **8** is mixed and combined with the source water **2** in step **1.08** with the intent to provide a chemical and biochemical mixture that would be conducive to the growth of plants **4** selected to be nurtured in the hydroponic pond **6**, optionally or additionally in accordance with a desired rate of input of the complementary formulation **8**, or individual components thereof, in light of the volume of water **2** contained within the hydroponic pond **6**. The complementary formulation **8** and the source water **2** are then combined and placed within the hydroponic pond **6** in relative volumes and amounts to result in the desired and intended concentrations of nutrients and other inputs in solution with the source water **2**. The chemistry and physical parameters of the hydroponic pond **6**, e.g., temperature, pH, and salinity, of the hydroponic pond **6** are monitored in repeated executions of step **1.10**, and the individual components of the complementary formulation **8** are input into the hydroponic pond **6** in iterative executions of step **1.08** in order to maintain a stable or desirably dynamic physical state of the hydroponic pond **6**. It is understood that additional inputs may be introduced into the source water **2** that are not included in the original complementary formulation **8** in one or more successive executions of step **1.08**.

FIG. **2**A is a top view of a hydroponic pond system **10**. The pond system **10** includes (a.) a pond tank **12** (hereinafter, "tank" **12**) having an external frame **12**A and an internal liner **12**B, wherein the liner **12**B is impermeable to water; (b.) a volume of pond water **16** that comprises a volume of source water **2**, the complementary formulation **8** and a plurality of plants **4**; and (c.) a control system **18**. The tank **12** has an internal length of the liner **12**B in the range of 78 to 100 feet along an X axis, and an internal width of the liner in the range

of 24 to 48 feet along a Y axis, wherein the Y axis is orthogonal to the X axis, and the X axis and the Y axis define a plane that is substantially parallel to the Earth's surface.

The tank may be or comprise a FOLDING FRAME TANK™ structure as marketed by Portable Tank Group of Sebastian, Fla., or other suitable fluid containing structure known in the art. The frame **12**A may be or comprise aluminum and/or other suitable rigid material known in the art, and the liner **12**B may be or comprise heavy duty vinyl standard **22**, heavy duty vinyl standard **28**, and/or other suitable water containment material known in the art.

The tank additionally, optionally or alternatively includes one or more of the following elements: A control system water intake pipe and valve **18**A (hereinafter, "control intake pipe" **18**A) comprising 2.0 inch Polyvinyl Chloride (hereinafter, "PVC") schedule **40** fluid pipe that accepts samples of pond water **16** from within the tank **12** at sampling port **18**A.**1** and delivers the samples of pond water **16** to the control system **18**, wherein the sampling port **18**A.**1** is positioned to be submerged within the pond water **16** when the hydroponic system **10** is growing plants **4**; A control system water outflow pipe **18**B (hereinafter, "control outflow pipe" **18**B) comprising size 2.0 inch PVC schedule **40** fluid pipe and having a nutrient port **18**B.**1** from which inputs, including nutrients, are delivered from the control system **18** and into the pond water **16**, wherein the nutrient port **18**B.**1** is located distally from the sampling port **18**A.**1** at a distance greater than one half of the width or length of the tank **12**, and wherein the nutrient port **18**B.**1** is positioned to be submerged within the pond water **16** when the hydroponic system **10** is growing plants **4**; A main air line **20** of ¾" outer diameter air pipe that delivers releases compressed air into air line lengths **22** and runs along a perimeter of the pond liner **12**A and within the tank **12**, wherein the air line lengths **22** are positioned to be submerged within the pond water **16** when the hydroponic system **10** is growing plants **4**; A plurality of additional air line lengths **22** comprising tubing having a ¾" outer diameter and located at intervals of 8 feet or closer within the liner **12**B, wherein the air line lengths **22** are coupled to, and receive compressed air from, the main air line **20**, and the air line lengths **22** are positioned to be submerged within the pond water **16** when the hydroponic system **10** is growing plants **4**; A plurality of air releasing and pressure compensating emitters **24** inserted in the range of every 36" into the air line lengths **22**, or with 18" spacing plus or minus 2 inches, wherein each air releasing emitter **24** may be or comprise a WOODPECKER JR™ part number DNJR12 one half gallon per hour pressure compensation air emitter as marketed by DripWorks, Inc. of Willits, Calif. or other suitable gas emitter device that is adapted to prevent pond water **16** backflow into the air line lengths **22** and therefrom into the main air line **20** when there is insufficient air pressure within the air line **20**.

FIG. **2**B is a detailed schematic of the hydroponic pond system **10** and presents the following optional features: T fixtures **26** that hermetically join each air line length **22** to the main air line **20** and enable gas and air to flow freely between the air line **20** and the air line lengths **22**; A source water channel **28** that provides a pathway for source water **2** into the tank **12** as enabled by a fluid pump module **30**; A drain channel **32** that provides an exit pathway of pond water **16** from the tank **12** as enabled by the fluid pump module and into a drain **34**; The fluid pump module **30** bi-directionally that is controlled by and communicatively coupled with the control system **18**, wherein the fluid pump module **30** as directed by the control system **18**, alternately (a.) simultaneously prevents or inhibits both source water **2** from entering the tank **12** via the source water channel **28** and pond water **16** from exiting the tank **12**; (b.) pumps source water **2** into the tank **16**; and pumps pond water **16** from the tank **12** and into the drain **32**; and An air channel **36** adapted to provide from a compressed air source **38** pressurized air **38**A and/or a gas **38**B containing oxygen to the air line **20** as alternately enabled and disabled by a gas valve module, wherein the gas valve module is controlled and directed by, and bi-directionally communicatively coupled, with the control system **18**, wherein the compressed air source **38** may be or comprise an EASY PRO™ diaphragm compressor air pump as marketed by Gast Manufacturing, Inc. of Benton Harbor, Mich., or other suitable source of compressed gas containing oxygen known in the art.

FIG. **3** is a cut away side view of the hydroponic system **10**. Each air line length **22** is positioned to be submerged by the pond water **16** within the tank **12** and is adapted to release oxygen from below a top surface **16**T of the pond water **16**; and is optionally adapted to release oxygen within a distance of one inch or less from an internal bottom surface **12**C of the liner **14**. A plurality of liner side walls **12**D extend along the Z axis and alternately along the A axis and Y axis to form side walls of the tank **12** and the hydroponic system **10**. The pond water top surface **16**T is in direct contact with an ambient air volume AA.

The depth dimension of the pond water **16** extends along a Z axis and from the pond water top surface **16**T of the pond water **16** to the internal bottom surface **12**C of the liner **14**. The Z axis is orthogonal to the X-Y plane as disclosed in FIG. **2**A. It is further understood that the internal liner bottom surface **12**C is in contact with the pond water **16** whereby the liner **12**B functions as an impermeable barrier and supports retaining the pond water **16** within the tank **12**. The depth dimension of the pond water **16** is in the range of from approximately 18 inches to approximately 36 inches. Presenting a depth dimension between approximately 18 inches+/−two inches to approximately 36 inches+/−two inches teaches against the prior art, wherein depths of less than two inches are taught to be preferable as reducing the amount of inputs required, and depths of greater than 36 inches are taught to maximize the resulting growth of plants **4**. The disclosed embodiments having the range of 18 inches+/−two inches to approximately 36 inches+/−two inches both encourages superior growth and plant yields while lowering energy consumption, operational costs, inputs of formulation **8** and components thereof, and other inputs.

An air port **42** of the air line **20** enables the air channel to hermetically couple with the air channel **36** and thereby accept air **38**A or oxygenated gas **38**B from the compressed air source **38** as enabled by the gas valve module **40**. A source port **44** enables a hermetic seal with the source water channel **28** and permits source water **2** to enter the tank **12** as alternately enabled and disabled by the fluid pump module **30**. A drain port **46** enables a hermetic seal with the drain channel **32** and permits pond water **16** to exit the tank **12** as alternately enabled and disabled by the fluid pump module **30**.

FIG. **4**A is a schematic of the control system **18** that is applicable to the hydroponic system **10** of FIGS. **2**A, **2**B and **3**. The control system **18** includes a processor C**1** (hereinafter, "processor" C**1**") that may be or comprise (a.) an internet-enabled mobile communications device; (b.) a VAIO FS8900™ notebook computer marketed by Sony Corporation of America, of New York City, N.Y., (c.) a SUN SPARC-SERVER computer workstation marketed by Sun Microsystems of Santa Clara, Calif. running LINUX or UNIX operating system; (d.) a personal computer configured for running WINDOWS XP™ operating system marketed by Microsoft Corporation of Redmond, Wash.; (e.) a PowerBook

G4™ personal computer as marketed by Apple Computer of Cupertino, Calif.; (f.) an Alienware M17x™ personal computer as marketed by the Dell Corporation; (g.) a Macbook Pro™ personal computer as marketed by Apple Computer of Cupertino, Calif.; or (h.) an internet enabled desktop computer; (h.) an iPad™ touch screen tablet personal computer as marketed by Apple Computer of Cupertino, Calif.; or (j) other suitable computational device adapted to receive and render digitized video data known in the art.

A plurality of sensors S1 through S9 are communicatively coupled with the control system **18**. The plurality of sensors may be or comprise a water electrical conductivity sensor S1; a water pH sensor S2; a water temperature sensor S3; a sensor S4 of dissolved oxygen concentration of the pond water **16**; an ambient air temperature sensor S5, an ambient air humidity sensor S6, an ambient air carbon dioxide sensor S7, an external air humidity sensor S8 and an external air temperature sensor S9.

The control system **18** may optionally include a plurality of input modules M1 through M8 including an oxygen module M1 that controllably delivers oxygen to the main air line **20** and air line lengths **22**, a nutritional additive dispenser module M2, an acidic agent dispenser M3A and/or a base material dispenser M3B. The acidic agent dispenser M3A may controllably dispense sulphuric acid, phosphoric acid, and/or other suitable acidic agent into the pond water **16** to reduce the pH of the pond water **16**. The base material dispenser M3B may controllably dispense potassium hydroxide and/or other suitable base material into the pond water **16** to raise the pH of the pond water **16**.

It is understood that the pH sensor S2 and the acid and base modules M3A & M3B may be separate devices, or may be an integrated device, such as a BL 7916™ pH controller and chemical dosing pump as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., or other suitable pH sensing, controlling and chemical dosing pumps known in the art, including integrated and functionally separated distributed pH sensors S2, and controlling and chemical dosing modules M3A & M3B. For example, the pH sensor S2 may be or comprise an HI 1286™ electrode pH indicator as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., or other suitable pH sensor known in the art.

Optionally, the controller system may include an HI 2500™ mini-controller fertigation system as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., to provide the functions of sensing and controlling the pH, salinity and electrical conduction properties of the pond water **16**.

Additionally or alternatively, the control system **18** may include a shading system M4 that controllably shields the pond water **16** and the ambient air volume AA from sunlight. Still additionally or alternately the control system **18** may include one or more motorized fans M5 that enable control or mitigation (a.) of air flow into the pond environment; and/or (b.) air flow away from the pond environment. Still additionally or alternatively, the control system **18** may include a carbon dioxide module M6 that controllably releases carbon dioxide gas into the ambient air volume AA of the hydroponic pond system **10**. Yet additionally or alternatively, the control system **18** may include an external air temperature and external air humidity sensor module M7; and a control system pump module M8. An electrical power source μl optionally provides electrical power to one or more control system elements C1-C3, M1-M8 & S1-S9 through an internal communications and power bus C1 (hereinafter, "bus" C2) or through one or more additional or alternate electrically conductive lines (not shown).

The sensors S1 through S9 and the input modules M1 through M8 are communicatively coupled to the processor C1 via the bus C2. A network interface module C3 communicatively couples the processor C1 via the control system internal communications bus C2 to the internet and/or other suitable electronics communications networks known in the art.

FIG. **4**B is a schematic diagram of aspects the control system **18** and the hydroponic system **10**. The processor C1 is illustrated to include a central processing unit C1 that is bidirectionally coupled with a processor memory C1M, wherein the processor memory C1M includes a system software SW.1. The system software SW.1 includes software encoded instructions that direct the central processing unit C1 to execute or instantiate the aspects of methods disclosed herein. The control system motorized pump module M8 causes pond water **16** to flow through a control system pipe **18**C, wherein the pond system pipe comprises the intake pipe **18**A and the out take pipe **18**B and whereby pond water **16** is circulated through the tank **12** and the control system pipe **18**C. A water filter **18**D is positioned within the control system pipe **18**C to filter the pond water **16** prior to the pond water contacting sensors S1-S4 or modules M2, M3A & M3A within the control system pipe **18**C. The water filter **18**D may be or comprise an S17A™ water purifier as marketed by Sanitron Industries PTE LTD of Singapore or other suitable water filtration products known in the art.

Selected sensors S1-S4 are inserted into the control system pipe **16**C and making contact with the pond water **16** therein. Selected modules M2, M3A & M3B are additionally inserted into the control system pipe **18**C whereby the inserted modules **18**C may deliver the nutrient composition **8**, acidic agents A1 and base materials B1 into the pond water **16**.

FIG. **4**C is a schematic diagram of aspects the control system **18** and the hydroponic system **10**. Selected sensors S5, S6 & S7 and modules M4 & M6 are shown to be exposed to the ambient air AA proximate to the pond water top surface **16**T and other selected sensors S8 & S9 and modules M4 & M5 are shown to be exposed to the environment external to the system **10** and the ambient air AA. In additional, selected sensors S1-S4 are shown to be submerged in the pond water and within the tank **12**.

Referring now to FIG. **5**, FIG. **5** illustrates a first control loop whereby the hydroponic system **10** maintains an oxygen level in the pond water **16** above a selected lower concentration level of six parts per million and below an upper concentration of ten parts per million. It is understood that methods may be applied to support maintenance of an alternate range of oxygen concentration level in the pond water **16**.

The processor C1 polls the dissolved oxygen sensor S4 in step **5**.**02** to generate a measurement of a current oxygen concentration of the pond water **16**. The dissolved oxygen sensor S4 may be or comprise an HI 76407/10™ standard dissolved oxygen probe as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., or other suitable dissolved oxygen probes known in the art. The processor C1 determines in step **5**.**04** whether the oxygen concentration measurement most recently received measurement from the oxygen concentration sensor S4 indicates that the oxygen concentration level of the pond water **16** is currently less than six parts per million. When the processor C1 determines in step **5**.**04** that the oxygen concentration measurement most recently received measurement from the oxygen concentration sensor S4 indicates that the oxygen concentration level of the pond water **16** is currently less than six parts per million, the control system **18** proceeds on to step **5**.**06** and to apply the oxygen module M1 to controllably deliver oxygen to the pond water **16** via the main air line **26** and the air line lengths **28** by energizing the

gas valve module **40** to deliver compressed gas to the main air line **26**. A wait step **5**.**08** is disposed in between step **5**.**06** and step **5**.**02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **5**.**04** that the oxygen concentration measurement most recently received measurement from the oxygen concentration sensor S**4** indicates that the oxygen concentration level of the pond water **16** is not currently less than six parts per million, the control system **18** proceeds on to step **5**.**10** and to determine whether the oxygen concentration of the pond water **16** is currently greater than ten parts per million. When the processor C**1** determines in step **5**.**10** that the oxygen concentration of the pond water **16** is currently greater than ten parts per million, the control system **18** proceeds to step **5**.**12** and to activate the fluid pump module **30** to pump pond water **16** out of the tank **16** and to simultaneously pump source water **2** into the tank **12**. The control system **18** optionally issue an alert of excessive oxygen concentration via the network interface C**2** in step **5**.**13** of the excessive oxygen concentration level detected in step **5**.**10**. Alternatively, when the processor C**1** determines in step **5**.**10** that the oxygen concentration of the pond water **16** is currently not greater than ten parts per million, the control system **18** proceeds from step **5**.**10** to step **5**.**14** and thereupon to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **5**.**102** through **5**.**16**, or (b.) proceed on to step **5**.**18** and to perform alternate operations. A wait step **5**.**16** is disposed in between step **5**.**14** and step **5**.**02** wherein the processor C**1** is available to perform alternate operations.

Referring now to FIG. **6**A, FIG. **6**A illustrates a second control loop whereby the hydroponic system **10** maintains a pH level in the pond water **16** above a preselected level, e.g., a pH of 5. It is understood that methods may be applied to support maintenance of an alternate pH range in the pond water **16**.

The processor polls the pH sensor S**2** in step **6**.**02** to generate measurement of a current pH level of the pond water **16**. The processor C**1** next determines in step **6**.**04** whether the pH most recently received measurement from the pH sensor S**2** indicates that the pH level of the pond water **16** is currently higher than the selected level. When the processor C**1** determines in step **6**.**04** that the pH most recently received measurement from the pH sensor S**2** indicates that the pH level of the pond water **16** is currently higher than the selected level, the control system **18** proceeds on to step **6**.**06** and to apply the acidic agent module M**3**A to controllably deliver an acidic agent A**1** to the pond water **16** and to reduce the pH of the pond water **16**. A wait step **6**.**08** is disposed in between step **6**.**06** and step **6**.**02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **6**.**04** that the pH most recently received measurement from the pH sensor S**2** indicates that the pH level of the pond water **16** is not currently higher than the selected pH level, the control system **18** proceeds on to step **6**.**10** and to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **6**.**02** through **6**.**12**, or (b.) proceed on to step **6**.**14** and to perform alternate operations. A wait step **6**.**12** is disposed in between step **6**.**10** and step **6**.**02** wherein the processor C**1** is available to perform alternate operations.

Referring now to FIG. **6**B, FIG. **6**B illustrates a third control loop whereby the hydroponic system **10** maintains a pH level in the pond water **16** above a lower preselected pH level, e.g., a pH of 4.9. It is understood that methods may be applied to support maintenance of an alternate pH range in the pond water **16**B.

The processor polls the pH sensor S**2** in step **6**B.**02** to generate measurement of a current pH of the pond water **16**B. The processor C**1** then determines in step **6**B.**04** whether the pH most recently received measurement from the pH sensor S**2** indicates that the pH level of the pond water **16** is currently lower than the lower preselected pH level. When the processor C**1** determines in step **6**B.**04** that the pH most recently received measurement from the pH sensor S**2** indicates that the pH level of the pond water **16** is currently lower than the lower preselected pH level, the control system **18** proceeds on to step **6**B.**06** and to apply the base material module M**3**B to controllably deliver a base material B**1** to the pond water **16** to raise the pH of the pond water **16**B. A wait step **6**B.**08** is disposed in between step **6**B.**06** and step **6**B.**02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **6**B.**04** that the pH most recently received measurement from the pH sensor S**2** indicates that the pH level of the pond water **16** is not currently lower than the lower preselected level, the control system **18** proceeds on to step **6**B.**10** and to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **6**B.**02** through **6**B.**12**, or (b.) proceed on to step **6**B.**14** and to perform alternate operations. A wait step **6**B.**12** is disposed in between step **6**B.**10** and step **6**B.**02** wherein the processor C**1** is available to perform alternate operations.

Referring now to FIG. **7**, FIG. **7** illustrates a first electrical conductivity ("EC") control loop whereby the hydroponic system **10** is adapted to attempt to maintain a salinity of the pond water **16** within a predetermined range. It is understood that methods may be applied to support maintenance of an alternate salinity range of the pond water **16**.

It is understood that electrical conductivity is a measure of salinity of the pond water, and further that salinity is an indication of a concentration of the formulation **8** in the pond water **16**. If the electrical conductivity is too low for a given set point, the control system **18** will add formulation **8** from the nutritional additive dispenser module M**2**, wherein the formulation **8** may contain any, some or all of a predetermined assortment of any of 23 minerals and nutrients known in the art. A typical range of electrical conductivity measurements of the EC sensor S**1** might be from, or include, 1.5 Siemens/meter to 4.0 Siemens/meter. In rare cases it could be outside these parameters. If the electrical conductivity measurement of the EC sensor S**1** is too high, than the system **10** adds source water **2** to the tank **12** and/or an alarm and shut down procedure will start for the irrigation system to prevent extreme salty water to be delivered to the plants.

The processor polls the EC sensor S**1** in step **7**.**02** to generate a measurement of a current EC level of the pond water **16**. The processor C**1** next determines in step **7**.**04** whether the EC measurement most recently received measurement from the EC sensor S**1** indicates that the EC level of the pond water **16** is currently below a lower EC limit. When the processor C**1** determines in step **7**.**04** that the EC measurement most recently received measurement from the EC sensor S**1** indicates that the EC level of the pond water **16** is currently less than the lower EC limit, e.g., the control system **18** proceeds on to step **7**.**06** and to instruct the nutritional additive dispenser module M**2** to controllably deliver the nutritional additive dispenser module M**2** to the pond water **16**. A wait step **7**.**08** is disposed in between step **7**.**06** and step **7**.**02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **7**.**04** that the EC measurement most recently received measurement from the EC sensor S**1** indicates that the EC level of the pond water **16** is not currently less than the lower EC limit, the control

system **18** proceeds on to step **7.10** and to determine whether the EC of the pond water **16** is currently greater than an upper EC limit. When the processor C**1** determines in step **7.10** that the EC of the pond water **16** is currently greater than the upper EC limit, e.g., 4.0 Siemens/meter, the control system **18** proceeds to step **7.12** and to activate the fluid pump module **30** to pump pond water **16** out of the tank **16** and to simultaneously pump source water **2** into the tank **12**. The control system **18** optionally issue an alert of excessive salinity via the network interface C**2** in step **7.13** of the excessive EC level, e.g., above 4.0 Siemens/meter, detected in step **7.10**. Alternatively, when the processor C**1** determines in step **7.10** that the EC of the pond water **16** is currently not greater than the upper EC limit, the control system **18** proceeds from step **7.10** to step **7.14** and thereupon to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **7.102** through **7.16**, or (b.) proceed on to step **7.18** and to perform alternate operations. A wait step **7.16** is disposed in between step **7.14** and step **7.02** wherein the processor C**1** is available to perform alternate operations.

As noted previously herein, the controller system may optionally include an HI 2500™ mini-controller fertigation system as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., to provide the functions of sensing and controlling the pH, salinity and electrical conduction properties of the pond water **16**. Alternatively, the EC sensor S**1** may be or comprise a HI 76300 ™ four-ring platinum conductivity probe as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., or other suitable electrical conductivity sensor known in the art. The nutritional additive dispenser module M**2** may be or comprise BL 7917 ORP™ controller and chemical dosing pump as marketed by Hanna Instruments, Inc., of Woonsocket, R.I., or other suitable plant nutrient dosing device known in the art.

Referring now to FIG. **8**, FIG. **8** includes a fifth control loop applied by the control system **18** of FIG. **4** to maintain the humidity of the ambient air volume AA of the hydroponic pond system **10** below a preselected humidity value. The control system **18** monitors both a data output of the air humidity sensor S**6** and the external air humidity sensor S**8** to determine when and how to direct one or more motorized fan modules M**5** to transfer air to or from the ambient air volume AA of the hydroponic pond system **10** in order to maintain air humidity of the ambient air volume AA proximate to the pond water **16** below the preselected humidity value.

The processor C**1** polls the humidity sensor S**6** in step **8.02** to generate a measurement of a current humidity measurement of the ambient air volume AA proximate to the pond water **16**. The processor C**1** the determines in step **8.04** whether the air humidity value of the most recently received measurement from the humidity sensor S**6** indicates that the level of air humidity of the ambient air volume AA proximate to the pond water **16** is higher the preselected humidity value. When the processor C**1** determines in step **8.04** that the humidity most recently received measurement from the humidity sensor S**6** indicates that the air humidity level of the air volume AA proximate to the pond water **16** is currently higher than the preselected humidity value, the control system **18** proceeds on to step **8.06** and to activate one or more motorized fan modules M**5**. A wait step **8.08** is disposed in between step **8.06** and step **8.02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **8.04** that the humidity most recently received measurement from the humidity sensor S**6** indicates that the humidity level of ambient air AA proximate to the pond water **16** is not currently higher than the preselected humidity value, the control system **18** proceeds on to step **8.10** and to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **8.02** through **8.12**, or (b.) proceed on to step **8.14** and to perform alternate operations. A wait step **8.12** is disposed in between step **8.10** and step **8.02** wherein the processor C**1** is available to perform alternate operations.

Referring now to FIG. **9**, FIG. **9** is a sixth control loop applied by the control system **18** to maintain the temperature of the ambient air volume AA of the hydroponic pond system **10** below a preselected temperature value. The control system **18** monitors both a data output of the air temperature sensor S**5** and a data output of the external air temperature S**9** to determine when and how to direct one or more motorized fan modules M**5** to transfer air to or from the ambient air volume AA of the hydroponic pond system **10** in order to maintain air temperature of the air volume AA proximate to the pond water **16** below the preselected temperature value.

The processor C**1** polls the temperature sensor S**5** in step **9.02** to generate a measurement of a current temperature measurement of the ambient air volume AA proximate to the pond water **16**. The processor C**1** then determines in step **9.04** whether the air temperature most recently received measurement from the temperature sensor S**5** indicates that the level of air temperature of the air volume AA proximate to the pond water **16** is higher the preselected temperature value. When the processor C**1** determines in step **9.04** that the temperature most recently received measurement from the temperature sensor S**5** indicates that the air temperature level of the air volume AA proximate to the pond water **16** is currently higher than the preselected temperature value, the control system **18** proceeds on to step **9.06** and to activate one or more motorized fan modules M**5**. A wait step **9.08** is disposed in between step **9.06** and step **9.02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **9.04** that the temperature most recently received measurement from the temperature sensor S**5** indicates that the temperature level of air proximate to the pond water **16** is not currently higher than the preselected temperature value, the control system **18** proceeds on to step **9.10** and to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **9.02** through **9.12**, or (b.) proceed on to step **9.14** and to perform alternate operations. A wait step **9.12** is disposed in between step **9.10** and step **9.02** wherein the processor C**1** is available to perform alternate operations.

Referring now to FIG. **10**, FIG. **10** is a seventh control loop applied by the control system **18** to maintain a carbon dioxide concentration level of the ambient air volume AA of the hydroponic pond system **10** above a preselected carbon dioxide concentration value. The control system **18** monitors a data output of the carbon dioxide concentration sensor S**7** to determine whether the carbon dioxide concentration of the air volume AA proximate to the pond water **16** is above a preselected carbon dioxide level.

The processor C**1** polls the carbon dioxide concentration sensor S**7** in step **10.02** to generate a measurement of a current temperature measurement of the ambient air volume AA environment of the pond water **16**. The processor C**1** the determines in step **10.04** whether the air temperature most recently received measurement from the carbon dioxide concentration sensor S**7** indicates that the carbon dioxide concentration of the air volume AA proximate to the pond water **16** is higher than the preselected carbon dioxide concentration level. When the processor C**1** determines in step **10.04** that the carbon dioxide concentration measurement of the most recently received measurement from the carbon dioxide concentration sensor S**7** indicates that the carbon dioxide

concentration level of the air proximate to the pond water **16** is currently higher than the preselected carbon dioxide concentration level, the control system **18** proceeds on to step **10.06** and to activate the carbon dioxide **48** of the controller carbon dioxide module M**6** to release gaseous carbon dioxide **50** to the air volume AA proximate to the pond water **16**. A wait step **10.08** is disposed in between step **10.06** and step **10.02** wherein the processor C**1** is available to perform alternate operations.

When the processor C**1** determines in step **10.04** that the carbon dioxide concentration measurement of the most recently received measurement from the carbon dioxide concentration sensor S**7** indicates that the temperature level of air proximate to the pond water **16** is not currently lower than the preselected carbon dioxide concentration value, the control system **18** proceeds on to step **10.10** and to determine whether the hydroponic system **10** shall (a.) process another iteration of the loop of steps **10.02** through **10.12**, or (b.) proceed on to step **10.14** and to perform alternate operations. A wait step **10.12** is disposed in between step **10.10** and step **10.02** wherein the processor C**1** is available to perform alternate operations.

FIG. **11** is a cut away side view of a second embodiment of the present disclosure **52** (hereinafter, "second system" **52**, a hemispheric dome **54** having a radius R substantially encloses two hydroponic ponds **56** & **58** and the ambient air volume AA. The dome may be or comprise a GREENHOUSE DOME™ as marketed by Pacific Domes, Inc. of Ashland Oreg. or other suitable sheltering system known in the art.

The two hydroponic ponds **56** & **58** are shaped and positioned to allow an access pathway **60**. The pathway **60** has a width dimension that is in the range of from two feet to one third of the radius R. Each hydroponic pond **56** & **58** has a maximum width dimension Y**2** & Y**3** of one third of the radius R and less than 8 feet to enable access to plants **4**.

It is understood that the pathway **60** may at least partly be populated with additional plants, such as vine plants **62**. One or more vine plants **62**, or other plants, located within the pathway **60** may be watered by means of drip irrigation delivery of source water **2** and/or pond water **16**.

FIG. **12** is a cut-away top view of the second system **52**. It is understood that either the second pond **56** or the third pond **58** may be divided into two or more compartments **56**A & **56**B, wherein each compartment **58**A & **58**B may have isolated pond water **16** and dedicated or shared control systems **18**. It is understood that selected sensors S**8** & S**9** may be positioned outside of the dome **54**. It is further understood that still other sensors S**5** & S**6** may be positioned within the ambient air volume AA enclosed within the dome **54**.

FIG. **13** is an isolated top view of the dome **54** of the second system **52**. A hoop door aperture **54**A enables worker access to the pathway **60**. One or more solar fans **54**B are comprised with fan modules M**5** and convert solar energy into electrical energy to at least partially power the fan modules M**5**. One or more fabric roll-up sheets **54**C enable varying sizing of apertures that enable air exchange between the ambient air volume AA and the environment external to the dome **54**.

FIG. **14** is a detailed top view of selected optional aspects of the system **10**. Two or a plurality of air emitters **24** are coupled with each air line length **22** and are spaced along its coupled air line length **22** at displacements in the range of from 12 inches to 36 inches away from any nearest other emitter **24**. In some embodiments, each emitter **24** is positioned in the range of from 12 inches to 36 inches from both any liner side wall **12** D and any other emitter **24**.

A buoyant sheet **66** supports a plurality of plants **4**, wherein a root structure **68** of each plant **4** may extend through the buoyant sheet **66** and toward the liner bottom **12**C.

FIG. **15** is a detailed top view of yet other selected optional aspects of the system **10**, wherein a plurality of buoyant sheets **66** float upon the pond water **16** proximate to the pond water top surface **16**T. Each sheet **66** includes one or more apertures **68** that enable each plant **4** to pass through the sheet **66** supporting the instant plant **4** and further enable the root structure **68** of each buoyantly supported plant **4** to from the top surface **16**T and toward the liner bottom **12**C, as shown in FIG. **3**. One or more sheets **66** are made of, or comprise, buoyant material, such as polystyrene, or other suitable buoyant materials known in the art, and may be shaped in various dimensions, such as between one and two inches thick along the Z-axis and having a length and width of approximately two feet by four feet.

The sheets **66** in combination generally extend over more than 90% of the top pond surface **16**T. In some embodiments, the sheets **66** in combination generally extend over more than 99% of the top pond surface **16**T, in order to lessen encouragement of growth of algae or any other undesired organism in the pond water **16**. The sheets **66** may be removed from contact with the pond top surface **16**T either individually or in subsets of sheets **66**, whereby the time of exposure and exposed surface area of the top pond surface are reduced or minimized in order to reduce or minimize the encouragement of algae growth or other undesired organisms in the pond water **16**.

It will be understood by skilled persons that many changes may be made to the details of the above-described embodiments without departing from the underlying principles of the invention. The scope of the present invention should, therefore, be determined only by the following claims.

I claim:

1. A hydroponic system having a control program to monitor a state of a hydroponic grow environment and control multiple input modules so as to facilitate cultivation of plants, the system comprising:

a tank having a depth in a range from about 24 inches to about 36 inches, the tank being configured to hold a water volume that provides a water depth greater than 24 inches;

a greenhouse encompassing the tank, the greenhouse adapted to impede ambient airflow to and from the tank;

an oxygen sensor adapted to measure an oxygen concentration of the water volume; an oxygen dispensing tube disposed within the water volume;

an oxygen source coupled with the oxygen dispensing tube and adapted to controllably deliver oxygen to the oxygen dispensing tube;

a pH sensor adapted to measure a pH level of the water volume;

an acid delivery module adapted to controllably release an acidic agent into the water volume;

a salinity sensor adapted to measure a salinity of the water volume;

a nutritional additive delivery module adapted to controllably release a nutritional additive into the water volume; and

a controller operably coupled to the oxygen sensor, the oxygen source, the pH sensor, the acid delivery module, the salinity sensor, and the nutritional additive delivery module, wherein the controller is responsive to the control program to:

direct the oxygen source to deliver oxygen to the oxygen dispensing tube in response to receiving the measured

oxygen concentration from the oxygen sensor and determining that the measured oxygen concentration is below a programmed oxygen concentration amount;

direct the acid delivery module to release the acidic agent into the water volume in response to receiving the measured pH level from the pH sensor and determining that the measured pH level is above a programmed pH level; and

direct the nutritional additive delivery module to release the nutritional additive into the water volume in response to receiving the measured salinity from the salinity sensor and determining that the measured salinity is below a programmed salinity amount.

2. The hydroponic system of claim **1**, wherein at least a portion of the oxygen dispensing tube releases oxygen within one inch of a bottom of the tank.

3. The hydroponic system of claim **1**, wherein at least a portion of the oxygen dispensing tube releases oxygen within ten inches of a top surface of the water volume.

4. The hydroponic system of claim **1**, wherein the controller is adapted to direct the oxygen source to release oxygen into the water volume to maintain the oxygen concentration of the water volume within a range of approximately six parts per million to ten parts per million.

5. The system of claim **1**, wherein the acidic agent comprises sulphuric acid.

6. The system of claim **1**, wherein the acidic agent comprises phosphoric acid.

7. The hydroponic system of claim **1**, further comprising:

a carbon dioxide sensor adapted to measure a concentration of carbon dioxide of a zone surrounding the water volume, the carbon dioxide sensor coupled with the controller; and

a carbon dioxide gas delivery module, the carbon dioxide gas delivery module coupled with the controller and adapted to release gaseous carbon dioxide into the zone as directed by the controller.

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